**Section: A**

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| **Q1:** | **Question 1 (8 marks)**  HiTech Electronics needs to distribute electronic products from its three factories (1, 2, and 3) to its three distribution centres (A, B, and C). Factories 1, 2 and 3 can supply 75, 45 and 90 units of the electronic product, respectively. Distribution centres A, B and C need to receive 80, 95, and 35 units, respectively.  1.a) HiTech Electronics has represented the problem as a transportation model using Table 1a below. Determine the values for the blanks indicated as **V** and **W** in Table 1a. (2 marks)  C:\Users\17046589\AppData\Roaming\Republic Poly\eQuest\_assessmentimages\_assessmentimg_-684736507_-318812526.png  Your answer:  V =  W = | **Mark (2)** |

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| **Q2:** | 1.b) State in words the objective of HiTech Electronics to achieve when planning the distribution of the electronic product. (1 mark) | **Mark (1)** |
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|  | Word Count: 14 | Max Words: 100 |

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| **Q3:** | 1.c) Use the **Lowest Cost Method**, determine the distribution plan for HiTech Electronics. Fill your answers in the following blanks. (3 marks)  Factory 1 to Distribution Centre A:  Factory 2 to Distribution Centre B:  Factory 3 to Distribution Centre C: | **Mark (3)** |

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| **Q4:** | 1.d) If HiTech Electronics intends to solve the product distribution problem above using Linear Programming, is it necessary to add constraints to the model to ensure that the optimal solution will have integer values? Explain. (2 marks) | **Mark (2)** |
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|  | Word Count: 57 | Max Words: 100 |

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**Section: B**

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| **Q5:** | **Question 2 (15 marks)**  Wendy has just graduated from a spa management course. She is thinking of opening a spa outlet in a big shopping mall. Considering the many competitors offering similar services, she plans to standout from her competitors through the following actions:   • Recruit well-trained staff who are professionals in providing excellent customer services.  • Offer a wide range of services, such as facial, massage, manicures, pedicures, etc. to satisfy various needs of customers.  2.a) State the **two** factors Wendy needs to consider when selecting the type of service process structure for the spa outlet. What is the process structure Wendy should employ? (3 marks) | **Mark (3)** |
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|  | Word Count: 35 | Max Words: 100 |

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| **Q6:** | 2.b) List **two** Operations Planning decision areas Wendy needs to consider and provide **one** example decision for each decision area. (4 marks). | **Mark (4)** |
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|  | Word Count: 40 | Max Words: 100 |

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| **Q7:** | 2.c) Identify the **two** competitive priorities that Wendy wants to leverage for the spa outlet to standout from her competitors. Provide **one** action she plans to take to support each competitive priority. (4 marks) | **Mark (4)** |
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|  | Word Count: 61 | Max Words: 100 |

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| **Q8:** | 2.d) It is important for Wendy to consider capacity requirement in her spa outlet. She is planning to buy a type of equipment to be used in the spa outlet. Assume that the desired capacity utilization level for the equipment is 80%, how many units of the equipment are required if the processing hours required each week is 300? Assume that the equipment operates 6 days a week at a 12-hour shift a day. (2 marks) | **Mark (2)** |
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|  | Word Count: 20 | Max Words: 100 |

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| **Q9:** | 2.e) Due to the uncertainties and fluctuations in customer demand, Wendy plans to add capacity to her spa outlet in small amount to match with demand as close as possible. What is the capacity change strategy employed by Wendy? State one disadvantage of this strategy. (2 marks) | **Mark (2)** |
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|  | Word Count: 26 | Max Words: 100 |

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**Section: C**

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| **Q10:** | **Question 3 (8 marks)**  A fast food restaurant operates 12 hours daily from 10am to 10pm. The restaurant employs both full-time and part-time staff scheduled according to staggered work shifts as shown in Figure 3a (F1 to F3 – full-time shifts 1 to 3; P1 to P4 – part-time shifts 1 to 4). Staff in each full-time shift work 9 hours with one hour meal break at the 5th hour. Staff in each part-time shift work three hours.  C:\Users\17046589\AppData\Roaming\Republic Poly\eQuest\_assessmentimages\_assessmentimg_-1595688513_93883456.png  To model the problem by integer programming, the decision variables are stated as follows: Fi is the number of full-time staff scheduled at full-time shift i (i=1, 2 and 3); Pj is the number of part-time staff scheduled at part-time shift j (j=1, 2, 3 and 4).  3.a) If the restaurant requires **at least 10 staff** to be on duty from 3pm to 4pm, write down the constraint for the given time period. (2 marks) | **Mark (2)** |
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|  | Word Count: 8 | Max Words: 100 |

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| **Q11:** | 3.b) The restaurant would like to maintain the number of full-time staff from 6 pm to 7 pm to be **at least 80%** of the total number of staff on duty. Formulate this constraint. (2 marks) | **Mark (2)** |
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|  | Word Count: 12 | Max Words: 100 |

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| **Q12:** | 3.c) The restaurant would like to minimize the total number of **staff** on duty. Write down the objective function. (2 marks) | **Mark (2)** |
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|  | Word Count: 24 | Max Words: 100 |

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| **Q13:** | 3.d) In general, a manpower scheduling problem is complex with many constraints to be taken into consideration. Give **two** common constraints the fast food restaurant may need to consider while doing the manpower scheduling. (2 marks) | **Mark (2)** |
|  |  | |
|  | Word Count: 41 | Max Words: 100 |

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**Section: D**

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| **Q14:** | **Question 4 (19 marks)**  *Show all your workings clearly and round off all answers to two decimal places when necessary.*  Nancy works as a production planner in a company specialized in manufacturing engine blocks. Currently the company produces four models of the engine blocks: Model A, Model B, Model C and Model D. Table 4a below shows the main processing times needed to produce one unit of each model. The unit profit of each model and the total amount of processing times available weekly are also given in Table 4a.  C:\Users\17046589\AppData\Roaming\Republic Poly\eQuest\_assessmentimages\_assessmentimg_567085162_-872578172.png  Nancy wants to apply Linear Programming (LP) to determine the mix of the four models to produce each week that will maximize the total profit.  4.A. Let X1, X2, X3 and X4 be the number of units of Model A, B, C, and D to produce, respectively.  4.A.a) Write down the objective function for Nancy’s LP problem. (2 marks) | **Mark (2)** |
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|  | Word Count: 11 | Max Words: 100 |

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| **Q15:** | 4.A.b) Write down the constraint for ‘Total shaping processing time used cannot exceed the amount available’. (2 marks) | **Mark (2)** |
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|  | Word Count: 5 | Max Words: 100 |

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| **Q16:** | 4.B. Nancy used MS Excel Solver to help her solve the LP model she formulated. She generated the answer and sensitivity reports as shown in Figure 4a below.  C:\Users\17046589\AppData\Roaming\Republic Poly\eQuest\_assessmentimages\_assessmentimg_-2036015449_-1998147672.png  Refer to Figure 4a to answer the following questions 4.B.a) to 4.B.e).  4.B.a) State the optimal number of Model C and Model D to be produced. (2 marks)  Your answer:  Model C:  Model D: | **Mark (2)** |

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| **Q17:** | 4.B.b) State one resource that Nancy will not use up in producing the optimal number of each model. Justify your answer. (2 marks) | **Mark (2)** |
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|  | Word Count: 23 | Max Words: 100 |

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| **Q18:** | 4.B.c) Assume that Nancy is able to get an additional 60 minutes of shaping processing time with all the other conditions remaining unchanged. (4 marks)  4.B.c)i) Determine the new optimal weekly profit.   4.B.c)ii) If the additional 60 minutes of shaping processing time will cost $240, explain why Nancy should get it. | **Mark (4)** |
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|  | Word Count: 58 | Max Words: 200 |

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| **Q19:** | 4.B.d) Assume that the unit profit of Model A is increased by $200, state and explain if the optimal solution would change. Determine the new reduced cost for Model A and justify your answer. (4 marks) | **Mark (4)** |
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|  | Word Count: 38 | Max Words: 100 |

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| **Q20:** | 4.B.e) For each unit of Model B, when the required cutting processing time is reduced by 6 minutes and the required amount of other processing times do not change, work out the minimum unit profit of Model B so that it is worthwhile to produce it. (3 marks) | **Mark (3)** |
|  |  | |
|  | Word Count: 72 | Max Words: 100 |

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