**Section: A**

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| **Q1:** | 2a)iv. In Figure 2a, is this graph considered a Maximally Planar Graph (MPG)? Why? (2 marks) | **Mark (2)** |
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|  | Word Count: 29 | Max Words: 100 |

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| **Q2:** | 1c)ii. Based on the characteristics above, what is the basic layout type that Luna will implement for Production Area B? (1 mark) | **Mark (1)** |

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| **Q3:** | 3g) The management asked Eren to use either 90o or 45o dock arrangement for the warehouse. If the company has 2 trucks and their lengths are 13.60m and 13.10m:  3g)i. Calculate the apron space that Eren should provide if he is using 90o dock with 10 feet (3.05m) safety factor. (2 marks) | **Mark (2)** |
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|  | Word Count: 10 | Max Words: 100 |

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| **Q4:** | 1b)ii. Find the values of **(P)**, **(Q)**, **(R)**,and **(S)**. (5 marks) | **Mark (5)** |
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|  | Word Count: 14 | Max Words: 100 |

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| **Q5:** | 3b)iii. “We should try to make sure that all available space are effectively and efficiently utilized.” (1 mark) | **Mark (1)** |

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| **Q6:** | **Question 5 (11 marks)**  Angela, the Office Manager at Hyrule Pte Ltd, was tasked to plan the office layout. Due to the company culture, multiple office space designs were recommended.  ***Show your workings or reasoning*** *clearly, round your answers to* ***two decimal places*** *when appropriate.*  5a) List **TWO** disadvantages of closed office space design. (2 marks) | **Mark (2)** |
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|  | Word Count: 22 | Max Words: 100 |

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| **Q7:** | 5d)ii. For her second drawing, Angela first drew a round table with only 1 chair. She wants to add 4 more chairs equally spaced surrounding the round table, as shown in Figure 5b. (1 mark)  C:\Users\17046589\AppData\Roaming\Republic Poly\eQuest\_assessmentimages\_assessmentimg_1794595751_-136384266.jpeg | **Mark (1)** |

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| **Q8:** | 1d) Production Area A will operate in 3 shifts and will hire a total of 300 operators to be equally divided among the 3 shifts (shift 1, 2, and 3). The company will also have 50 administrative and management staff working in shift 1. If the company wants to provide only first aid Box B, how many first aid Box B does the company need to provide for Production Area A, according to the MOM’s Workplace Safety and Health (First Aid) Provisions? (5 marks) | **Mark (5)** |
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|  | Word Count: 21 | Max Words: 200 |

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| **Q9:** | 4b) How many groups of machine cells are formed using Row & Column Masking (R&CM)? (1 mark) | **Mark (1)** |

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| **Q10:** | 3f)ii. Propose **ONE** way to improve the space standard of the warehouse. Explain how your suggested way can improve the space standard of the warehouse. (2 marks) | **Mark (2)** |
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|  | Word Count: 16 | Max Words: 100 |

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| **Q11:** | 5d) Angela also needs to draw her layout using AutoCAD Architecture 2018. State the most efficient **AutoCAD command / function** that Angela should use for each of the situations below.  5d)i. For her first drawing, Angela formed a rectangle using 4 individual lines. For each of these original lines, she wants to draw one new parallel line with specific same distance from the original line, as shown in Figure 5a. (1 mark)  C:\Users\17046589\AppData\Roaming\Republic Poly\eQuest\_assessmentimages\_assessmentimg_-1003674629_1935278637.jpeg | **Mark (1)** |

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| **Q12:** | 2b)iii. If the minimum space requirement (without aisle space) for **X** number of E3 equipment (bending machine) is 40m2, and E3 equipment’s dimension (Length x Width) is 5m by 4m, determine the value of **X**. (2 marks) | **Mark (2)** |
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|  | Word Count: 18 | Max Words: 100 |

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| **Q13:** | 5b) The research and development department needs to be able to communicate easily to work on their projects. What type of office layout should Angela recommend for this department? Give **ONE** reason. (2 marks) | **Mark (2)** |
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|  | Word Count: 23 | Max Words: 100 |

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| **Q14:** | 3b) Based on the following statements, identify the **material handling principle** which Eren is describing.  3b)i. “We should try to limit the variety of material handling method and equipment used as far as possible.” (1 mark) | **Mark (1)** |

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| **Q15:** | 2b)ii. To confirm that the Japan Factory has enough number of equipment, Harry decided to re-calculate the number of equipment required. Currently the Japan Factory has two units of E2 equipment (painting machine). Is it enough? Why? Assume E2 equipment’s gross output is 1600, and its efficiency rate is 85%. (8 marks) | **Mark (8)** |
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|  | Word Count: 53 | Max Words: 300 |

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| **Q16:** | 2b) For Japan Factory, Harry wants to improve the material flow at the production floor. Table 2c is the routing table for the four different products (P1, P2, P3 and P4) being made in a factory (E1: cutting machine, E2: painting machine, E3: bending machine, E4: final assembly table, and F1: finish goods area).  C:\Users\17046589\AppData\Roaming\Republic Poly\eQuest\_assessmentimages\_assessmentimg_680910978_-844436727.jpeg  2b)i. Harry is trying to come up with a From-To Chart as shown in Table 2d with reference to the information given in Table 2c. Find the **batch size for P1**, values of **(K)** and **(L)**. (5 marks)  C:\Users\17046589\AppData\Roaming\Republic Poly\eQuest\_assessmentimages\_assessmentimg_680910978_-1849699273.jpeg | **Mark (5)** |
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|  | Word Count: 46 | Max Words: 100 |

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| **Q17:** | 4c) State **TWO** benefits of Group Technology and Cellular Manufacturing. (2 marks) | **Mark (2)** |
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|  | Word Count: 22 | Max Words: 100 |

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| **Q18:** | 2a)ii. In Figure 2a, which face should Harry choose as the location for the next entering department (number 5)? Assume LSa value for IF1, IF2, and IF3 are 1010, 110, and 1100 respectively. Explain the reasoning. (3 marks) | **Mark (3)** |
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|  | Word Count: 26 | Max Words: 100 |

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| **Q19:** | 3a)iii. “Moving units of products over a fixed path from point A to point B on a flat surface.” (1 mark) | **Mark (1)** |

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| **Q20:** | 5d)iii. Angela wants her cursor to be automatically directed to the end of the line. (1 mark) | **Mark (1)** |

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| **Q21:** | 3g)iii. List **TWO** equipment requirements for docking operations. (2 marks) | **Mark (2)** |
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|  | Word Count: 25 | Max Words: 100 |

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| **Q22:** | 3g)ii. If the actual maximum apron space available outside the warehouse is 31.50m, and Eren chose the 45o dock arrangement, do you agree with Eren? Why? Assume the bay width is adequate for both 90o and 45o dock arrangement. (2 marks) | **Mark (2)** |
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|  | Word Count: 24 | Max Words: 100 |

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| **Q23:** | 2a)v. If LSa = LSaUB, what can you say about the REL Graph? (1 mark) | **Mark (1)** |

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| **Q24:** | 5c) State **TWO** recent office layout trends. (2 marks) | **Mark (2)** |
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|  | Word Count: 6 | Max Words: 100 |

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| **Q25:** | 5d)v. For her fourth drawing, Angela wants to color her square with a solid green as shown in Figure 5d. (1 mark)  C:\Users\17046589\AppData\Roaming\Republic Poly\eQuest\_assessmentimages\_assessmentimg_-252535188_-440280229.jpeg | **Mark (1)** |

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| **Q26:** | 4e) Lily’s manager tasked her to use another method, CORELAP, to develop an alternative layout. Figure 4a reflects the step after she placed the first two departments (Department 1 & 3) and is about to place the third department (Department 2).  C:\Users\17046589\AppData\Roaming\Republic Poly\eQuest\_assessmentimages\_assessmentimg_1951041845_489812428.jpeg  4e)i. Determine the partial adjacency (alpha) value that Lily used. (2 marks)  4e)ii. If the alpha value used is 0.8, what is the Weighted Placement (WP) value as shown in Figure 4a? (2 marks) | **Mark (4)** |
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|  | Word Count: 34 | Max Words: 100 |

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| **Q27:** | 5d)iv. For her third drawing, Angela wants to delete some excess lines to make a perfect square as shown in Figure 5c. (1 mark)  C:\Users\17046589\AppData\Roaming\Republic Poly\eQuest\_assessmentimages\_assessmentimg_-1730356629_1743841605.jpeg | **Mark (1)** |

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| **Q28:** | 4d) Apart from using Row & Column Masking (R&CM), what is the other commonly used clustering algorithm? (1 mark) | **Mark (1)** |

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| **Q29:** | **Question 3 (31 marks)**    Eren has been engaged as a consultant to help in the layout design for a new manufacturing facility.    ***Show your workings or reasoning*** *clearly, round your answers to* ***two decimal places*** *when appropriate.*  3a) Based on the following described scenarios, what is the most suitable **material handling system** that Eren should suggest to implement?  3a)i. “Need to ensure that the products are stored and retrieved in a first-in-first-out (FIFO) manner.” (1 mark) | **Mark (1)** |

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| **Q30:** | 3f) Eren is now tasked to improve the current space standard of the warehouse.  3f)i. Thus, Eren decided to **increase** the value of space standard of the warehouse. Do you agree? ("Yes" or "No") (1 mark) | **Mark (1)** |

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| **Q31:** | 3a)ii. “There are a few hundred different types of small components that need to be stored and retrieved efficiently and accurately”. (1 mark) | **Mark (1)** |

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| **Q32:** | 2a)iii. In Figure 2a, is this graph considered a planar graph? Why? (2 marks) | **Mark (2)** |
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|  | Word Count: 20 | Max Words: 100 |

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| **Q33:** | 3c) Eren was informed that a Narrow Aisle Truck and a 1-ton Forklift are to be used in the facility for materials handling purpose. With reference to the aisle width provision guideline provided in Table 3a:  3c)i. What is the recommended minimum aisle width for each of the Narrow Aisle Truck and the 1-ton Forklift, respectively? (2 marks)  3c)ii. If a third type of materials handling equipment, a manual platform truck, is to be used in the facility as well, what is the minimum aisle width that should be provided if all the 3 material handling equipment are to share a common aisle around the facility due to the limited space? Why? (2 marks)  C:\Users\17046589\AppData\Roaming\Republic Poly\eQuest\_assessmentimages\_assessmentimg_-1758769502_-1353537051.jpeg | **Mark (4)** |
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|  | Word Count: 57 | Max Words: 200 |

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| **Q34:** | 1b) Table 1a shows a table that Luna and her team has come up while choosing the location of the new factory based on factor A, B, and C. She completed Table 1a based on the management’s inputs as shown in Figure 1a.  C:\Users\17046589\AppData\Roaming\Republic Poly\eQuest\_assessmentimages\_assessmentimg_1799920639_-910362872.jpeg  1b)i. What did the management do as shown in Figure 1a? (1 mark) | **Mark (1)** |

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| **Q35:** | 1c)iii. Based on the characteristics above, what is the basic layout type that Luna will implement for Production Area C? (1 mark) | **Mark (1)** |

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| **Q36:** | 3d) Eren is also in charge of the warehouse’s layout. He was informed that the dimension (Length x Width x Height) of the unit load is 1.5m x 1m x 1.8m, and the dimension (Length x Width x Height) of a rack is 3.5m x 1.2m x 6m.  3d)i. How many unit loads are there in one stack? (2 marks)  3d)ii. How many stacks are there in one rack? (2 marks)  3d)iii. How many unit loads are there in one rack? (2 marks)  3d)iv. How many racks should Eren provide in the warehouse? Assume the targeted capacity of the warehouse is 175 unit loads. (2 marks)  3d)v. What is the total number of unit loads that can be stored in the warehouse based on Q3d)iv.? (2 marks) | **Mark (10)** |
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|  | Word Count: 32 | Max Words: 300 |

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| **Q37:** | **Question 2 (24 marks)**    Gryffindor Pte Ltd is a company that produces various models of sport equipment. To stay relevant and competitive, the company decided to do re-layout for the production floor at their 2 factories: Singapore Factory and Japan Factory. The management has appointed Harry and his team to plan and design the new layout of the production floor for both factories.    ***Show your workings or reasoning*** *clearly, round your answers to* ***two decimal places*** *when appropriate.*  2a) For Singapore Factory, Harry has come up with a drawing as shown in Figure 2a using one of the methods that he has learnt to arrange the facilities. He will complete his drawing in Figure 2a based on Table 2a and Table 2b.    C:\Users\17046589\AppData\Roaming\Republic Poly\eQuest\_assessmentimages\_assessmentimg_2013031615_379464097.jpeg    C:\Users\17046589\AppData\Roaming\Republic Poly\eQuest\_assessmentimages\_assessmentimg_2013031615_-1154394606.jpeg    2a)i. What is the name of this method that Harry is using? (1 mark) | **Mark (1)** |

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| **Q38:** | **Question 1 (20 marks)**    Ravenclaw Pte Ltd is a company that produces various models of smart watch. Recently, the company decided to open a new factory in Osaka. The management has appointed Luna and her team to plan and design the layout for this new factory.    ***Show your workings or reasoning*** *clearly, round your answers to* ***two decimal places*** *when appropriate.*    1a) List down the **SIX** steps of facilities planning process that Luna should implement if she wants to apply the engineering design approach. (6 marks) | **Mark (6)** |
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| **Q39:** | 3b)ii. “We should consider potential human capabilities and limitations in designing our materials handling system as much as possible.” (1 mark) | **Mark (1)** |

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| **Q40:** | **Question 4 (14 marks)**  Lily, the Production Manager at Boruto Pte Ltd, needs to establish a Group Layout and achieve cellular manufacturing for the company. She tabulated the usage data on the various machines by the various products that the company produced as shown in Table 4a.  ***Show your workings or reasoning*** *clearly, round your answers to* ***two decimal places*** *when appropriate.*  *C:\Users\17046589\AppData\Roaming\Republic Poly\eQuest\_assessmentimages\_assessmentimg_-1160196459_-836965129.jpeg*  Number ‘1’ denotes that the product utilizes the machine, while number ‘0’ denotes that the product does not utilize the machine.  4a) Lily wants to use Row & Column Masking (R&CM).  4a)i. State down all the **products** that should be grouped together with **P1** as a part family. (3 marks)  4a)ii. In addition, list down all the **machines** that should be grouped in the machine cell that processes the **P1** part family. (3 marks) | **Mark (6)** |
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| **Q41:** | 3e) Because of some plan changes, Eren needs to redo his rack calculation for the warehouse. From the new calculation, he found out that the total number of unit load that can be stored in the warehouse is now 250 units. If the total warehouse space is 5000m3, determine the space standard of the warehouse. (2 marks) | **Mark (2)** |
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| **Q42:** | 1c) The new factory will have 3 production areas. Below are their characteristics:   Production Area A: Different types of machines are grouped together to process items with similar processing requirements.   Production Area B: Machines are arranged in a line according to process flow of each product, and are connected by conveyor belt.   Production Area C: Same type of machines are grouped together.  1c)i. Based on the characteristics above, what is the basic layout type that Luna will implement for Production Area A? (1 mark) |

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