**Section: A**

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| **Q1:** | **Question 1** (1 mark) If a company wishes to measure how efficiently and effectively it uses labour to produce outputs such as goods and services, which of the following should it measure? | **Mark (1)** |
|  | Takt time | |
|  | Sales per employee | |
|  | Value added time | |
|  | Labour productivity | |

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| **Q2:** | **Question 2** (1 mark) Which of the following tools is used to translate customers’ expectations or needs into quantitative specifications? | **Mark (1)** |
|  | Value stream mapping | |
|  | Cause and effect | |
|  | Critical to Quality | |
|  | Process flowchart | |

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| **Q3:** | **Question 3** (1 mark) Calculate the time to complete an improvement project using the below information and PPI is the Pareto Priority Index of the project.                                        Table 3a: Information for an improvement project  C:\Users\17046589\AppData\Roaming\Republic Poly\eQuest\_assessmentimages\_assessmentimg_1209720665_744279382.png | **Mark (1)** |
|  | 0.5 | |
|  | 2.0 | |
|  | 1.0 | |
|  | 1.5 | |

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| **Q4:** | **Question 4** (1 mark) Figure 4a shows how the continuous movement of the operations staff is involved in various processes in a cafe. What is Figure 4a known as?  C:\Users\17046589\AppData\Roaming\Republic Poly\eQuest\_assessmentimages\_assessmentimg_-1244260768_-1281213149.jpeg  Figure 4a: Movement of the staff involved in various processes | **Mark (1)** |
|  | Network diagram | |
|  | Spaghetti diagram | |
|  | Process Mapping | |
|  | Value Stream Mapping | |

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| **Q5:** | **Question 5** (1 mark) Different types of Failure Modes and Effects Analysis (FMEA) are used in different circumstances. Process FMEA is | **Mark (1)** |
|  | a lean-management method for analyzing the current state and designing a future state for the series of events that take a product or service from its beginning through to the customer | |
|  | focused on risks stemming from how the equipment is manufactured, maintained or operated | |
|  | looking for potential problems and bottlenecks in global system functions | |
|  | carried out to eliminate failures during equipment design, taking into account all types of failures during the whole life-span of the equipment | |

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**Section: B**

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| **Q6:** | **Question 6** (15 marks) Show your workings clearly and state any assumptions made. Your answers should be rounded to 2 decimal places wherever applicable.  A local manufacturing company, operating on a 9-hour shift per day, is supplying a major component to their major customer who builds refrigerators. The process engineer has drafted a Value Stream Map (VSM) using Quality Companion for his supervisor in the upcoming meeting on the agenda of process improvement and efficient use of manpower. Due to some unforeseen reason, there are some missing numbers which need to be verified.  C:\Users\17046589\AppData\Roaming\Republic Poly\eQuest\_assessmentimages\_assessmentimg_597369526_1244075373.png  Figure 6a: Value stream map of the manufacturing process  a) Refer to Figure 6a, what does the “Zig-zag” arrow symbol with the label “Orders” represent? (1 mark)    () | **Mark (1)** |

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| **Q7:** | b) Refer to Figure 6a, what does the triangle with I C:\Users\17046589\AppData\Roaming\Republic Poly\eQuest\_assessmentimages\_assessmentimg_-1822488740_45543485.jpeg  represent? (1 mark)    () | **Mark (1)** |

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| **Q8:** | c) Assuming 9 working hours with 1 hour break and a Takt time of 80mins. The company operates 20 days per month. What is the customer demand in number of pieces per month for the process? (4 marks) | **Mark (4)** |
|  |  | |
|  | Word Count: 13 | Max Words: 200 |

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| **Q9:** | d) What is the Total Cycle time (in minutes) for the process? (2 marks) | **Mark (2)** |
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|  | Word Count: 8 | Max Words: 100 |

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| **Q10:** | e) Calculate the Value-Added % (VA%) of the process. Comment on the results obtained, stating clearly the value of VA%. Assume Total Value-Added Cycle time is 3 hours. (5 marks) | **Mark (5)** |
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|  | Word Count: 56 | Max Words: 500 |

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| **Q11:** | f) Currently, the assembly line is deploying straight line layout. Suggest a layout shape that the company can adopt to increase its operators’ flexibility across operations. Explain with ONE reason.  (2 marks) | **Mark (2)** |
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|  | Word Count: 26 | Max Words: 100 |

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| **Q12:** | **Question 7** (15 marks) A research centre wishes to compare an equipment usage duration for different factors at different levels.  Figures 7a to 7d show the Minitab outputs for the analysis of the test results.  C:\Users\17046589\AppData\Roaming\Republic Poly\eQuest\_assessmentimages\_assessmentimg_10663293_872800038.png  Figure 7a: Minitab Output for Usage duration versus Staff, Equipment, Shift  C:\Users\17046589\AppData\Roaming\Republic Poly\eQuest\_assessmentimages\_assessmentimg_10663293_878894967.jpeg      Figure 7b: Minitab Output for usage duration versus Staff        Figure 7c: Minitab Output for usage duration versus Equipment       Figure 7d: Minitab Output for usage duration versus Shift  a) For each factor, what are the different levels (state clearly the values for each level) used in the analysis? (3 marks) | **Mark (3)** |
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|  | Word Count: 39 | Max Words: 100 |

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| **Q13:** | b) For this hypothesis test, state the hypothesis statements and the significance level. (3 marks) | **Mark (3)** |
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|  | Word Count: 20 | Max Words: 100 |

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| **Q14:** | c) State TWO assumptions made for this hypothesis test conducted. (2 marks) | **Mark (2)** |
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|  | Word Count: 27 | Max Words: 150 |

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| **Q15:** | d) Refer to Figures 7b to 7d. State if each factor is significant based on the Minitab outputs for One-Way ANOVA for each of the factors. (3 marks) | **Mark (3)** |
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|  | Word Count: 74 | Max Words: 200 |

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| **Q16:** | e) Provide any TWO observations from the Multi-Vari Chart shown in Figure 7e below. (4 marks)  C:\Users\17046589\AppData\Roaming\Republic Poly\eQuest\_assessmentimages\_assessmentimg_645359379_-2074487371.png  Figure 7e: Multi-Vari chart of Usage Duration, Staff, Equipment and Shift | **Mark (4)** |
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|  | Word Count: 24 | Max Words: 100 |

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| **Q17:** | **Question 8** (15 marks) Show your workings clearly and state any assumptions made. Your answers should be rounded to 2 decimal places wherever applicable.  At the beginning of the year, the operations director has set new targets for some parameters of the Overall Equipment Effectiveness (OEE) to achieve the “Availability” of machines to be 85%, the “Performance” to be 93% and the “OEE” to be 77%.  In order to meet the new parameters’ targets, James, the production manager has gathered some historical data of the activities and performance of a machine as shown in Table 8a. He is curious to know what the three missing data would be in order to meet the new targets.  The total working hours in the company is 12 hours per day.                Table 8a: Data collected on a machine for a day   |  |  | | --- | --- | | **Activities** | **Time Taken / Performance** | | Total lunch time | 60 minutes | | Total tea-break time | 20 minutes | | Downtime for regular maintenance | ? | | 1 breakdown due to setup | 5 minutes | | 1 breakdown due to changeover | 10 minutes | | 2 breakdown due to equipment failure | 15 minutes each breakdown | | Ideal cycle time | 30 seconds | | Total production quantity produced | ? | | Rejected quantity | ? |   a) Determine the expected “Downtime for regular maintenance”. (7 marks) | **Mark (7)** |
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|  | Word Count: 54 | Max Words: 150 |

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| **Q18:** | b) Determine the total production quantity produced. Round off your answer to the nearest integer. (3 marks) | **Mark (3)** |
|  |  | |
|  | Word Count: 25 | Max Words: 100 |

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| **Q19:** | c) Determine the “Rejected Quantity”. Round off your answer to the nearest integer. (5 marks) | **Mark (5)** |
|  |  | |
|  | Word Count: 22 | Max Words: 100 |

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