**Section: A**

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| **Q1:** | **Question 1 (20 marks)** Show your workings clearly and state any assumptions made. Your answers should be rounded to 2 decimal places wherever applicable.  Melvin is the marketing manager of a toy factory. This toy factory operates 8 hours per day and 312 days per year. Based on customer order, the factory is to produce 250 toys in a month. Assume the factory operates each month in a year.  1a) Calculate the TAKT time for the toy making process. (7 marks) | **Mark (7)** |
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|  | Word Count: 34 | Max Words: 300 |

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| **Q2:** | 1b) If the workers need an average time of 1.2 hours to produce 1 toy, comment whether factory is able to meet customer’s demand. Explain. (2 marks) | **Mark (2)** |
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|  | Word Count: 29 | Max Words: 100 |

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| **Q3:** | 1c) Melvin has conducted customer surveys to seek the voice of his customers. There were several feedbacks on improving a small design on a toy for toddlers. Is this small design change too small a VOC project? Explain with ONE reason. (2 marks) | **Mark (2)** |
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|  | Word Count: 20 | Max Words: 100 |

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| **Q4:** | 1d) Melvin has created a deployment flow chart for his toy ordering process. Name TWO purposes of the deployment flow chart. (2 marks) | **Mark (2)** |
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|  | Word Count: 29 | Max Words: 100 |

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| **Q5:** | 1e) Melvin’s team has brainstormed a few improvement projects and proposed to use Pareto Priority Index (PPI) to help in evaluating the various projects. List down TWO key components which the PPI takes into consideration when prioritizing projects. (2 marks) | **Mark (2)** |
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|  | Word Count: 6 | Max Words: 100 |

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| **Q6:** | 1f) Currently the machines in the toy factory are unable to auto-detect defects that occur during production. The production manager would like to improve on the current machines. Suggest a suitable lean concept to the production manager and list TWO benefits of this concept. (3 marks) | **Mark (3)** |
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|  | Word Count: 24 | Max Words: 100 |

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| **Q7:** | 1g) There are production and start-up defects in the toy factory. Explain the difference between these two defects. (2 marks) | **Mark (2)** |
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|  | Word Count: 27 | Max Words: 100 |

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| **Q8:** | **Question 2 (10 marks)**  Show your workings clearly and state any assumptions made. Your answers should be rounded to 2 decimal places wherever applicable.  The cupcake shop has been encountering high over baked burnt cupcakes which are not suitable for sale. Sara, the shop’s owner has decided to analyse the causes of the burnt cupcakes. She has brainstormed with her fellow workers and came up with a FMEA table as shown in Table 2a.  Table 2a: FMEA Table for ‘Over baked burnt cupcakes’  C:\Users\17046589\AppData\Roaming\Republic Poly\eQuest\_assessmentimages\_assessmentimg_813191249_261721078.jpeg  Refer to Table 2a and answer the following questions.  2a) Calculate the value for **a(i)**. (2 marks) | **Mark (2)** |
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|  | Word Count: 5 | Max Words: 100 |

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| **Q9:** | 2b) Comparing to using hand as a design control, would you expect **b(i)** to have a higher or lower likelihood than 8 for detecting its cause of failure? Explain. (2 marks)  2c)  Recommend a design control for **c(i)**. (2 marks)  2d) If corrective action is needed for items with RPN > 100, list down one item that would need corrective action. Assume the RPN number for Item B is 72. (2 marks) | **Mark (6)** |
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|  | Word Count: 62 | Max Words: 200 |

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| **Q10:** | 2e) One column is missing from the FMEA table in Figure 2a, name this column and describe the importance of this column in FMEA. (2 marks) | **Mark (2)** |
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|  | Word Count: 42 | Max Words: 100 |

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| **Q11:** | **Question 3 (15 marks)** Show your workings clearly and state any assumptions made. Your answers should be rounded to 2 decimal places wherever applicable.  Ryan who is a manufacturing engineer for a factory noted that a particular machine is scheduled to run nonstop for 8 hours for each working day. However, after running for 130 minutes, it broke down due to oil leakage and took 25 minutes to recover. After running for another 65 minutes, machine broke down for 35 minutes due to tooling breakage. It then continued to run for another 40 minutes before the Andon light turned red for a worn out belt that halted the machine for the rest of the work day.  3a) Calculate the Mean Time Between Failure (MTBF) and Mean Time to Repair (MTTR) of the machine for the shift. (7 marks) | **Mark (7)** |
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|  | Word Count: 49 | Max Words: 200 |

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| **Q12:** | 3b) Ryan has learned that the company’s policy is to assume the operating time to be the same as MTBF and the Planned Production Time is the sum of MTBF and MTTR. The company targets to achieve the world class level for “Availability”.  Based on the information on what Ryan has noted, explain if the company can fulfil that. (6 marks) | **Mark (6)** |
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|  | Word Count: 81 | Max Words: 200 |

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| **Q13:** | 3c) Ryan intends to improve the machine’s availability by implementing one of the eight pillars of TPM – Planned maintenance while minimizing the production downtime. Explain why planned maintenance is implemented. (2 marks) | **Mark (2)** |
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|  | Word Count: 56 | Max Words: 100 |

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| **Q14:** | **Question 4 (15 marks)** John, the production manager, wants to improve his shop floor and hence formed a team to identify areas of improvement. A list of problem areas has been identified which are regarded as “waste”.  4a) For each of the following scenarios below, identify the type of “waste” for each of the problematic area. Explain the consequence of having the identified “waste”.  i. He observed certain processes in the shop floor with bottlenecks and the products require additional lead time. Workers are seen idling. (2 marks)  ii. The poor layout as well as process design and planning caused unnecessary movement of items between processes and inventory. (2 marks)  iii. He observed that the production of items are earlier than scheduled or in greater quantities than required for customer demand. (2 marks) | **Mark (6)** |
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|  | Word Count: 58 | Max Words: 250 |

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| **Q15:** | 4b) John has also observed that the shop floor is untidy and is in need of a cleanup. He has activated his staff to conduct a 5S session. One of his staff commented that the ‘Red Tag’ should be used in the ‘Shine’ step of 5S.     Do you agree with the above comment by the staff? Explain. (3 marks) | **Mark (3)** |
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| **Q16:** | 4c) During the 5S implementation, the staff used some signboards to differentiate different items on the shelves and claimed to be implementing the ‘Standardize’ step of 5S.  Do you agree with the staff? Explain. (2 marks) | **Mark (2)** |
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|  | Word Count: 30 | Max Words: 100 |

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| **Q17:** | 4d) Besides DMAIC, John has also heard about DFSS. Name TWO major differences between DMAIC methodology and DFSS. (2 marks) | **Mark (2)** |
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| **Q18:** | 4e) During a Six Sigma Project closure, identify TWO areas that the Six Sigma team is required to ensure. (2 marks) | **Mark (2)** |
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| **Q19:** | **Question 5 (20 marks)** A FYP student is producing a metal part for his project using a lathe machine. He wants to investigate the relationship between the “surface finish” of the metal part and the following factors such as “cutting speed”, “tool material” and “material hardness”. He conducted a Design of Experiment (DOE) study and his data are tabulated in the below Table 5a.  Table 5a: Data from DOE study of metal part  C:\Users\17046589\AppData\Roaming\Republic Poly\eQuest\_assessmentimages\_assessmentimg_783000577_-546261400.jpeg  5a) Refer to the above Table 5a and answer the following questions.  i) To represent the study with “Y=f(X)”, identify the ‘Y’ and ALL the ‘X’(s). (4 marks)  ii) How many factors are considered in the study? (1 mark)  iii) How many levels for each factor in the study? (1 mark)  iv) How many replications are used in the study? (1 mark) | **Mark (7)** |
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|  | Word Count: 58 | Max Words: 200 |

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| **Q20:** | 5b) Figure 5a shows the Pareto chart of the effects captured in the Minitab output.  C:\Users\17046589\AppData\Roaming\Republic Poly\eQuest\_assessmentimages\_assessmentimg_1775346619_1956060769.jpeg  Figure 5a: DOE pareto chart  i) Based on Figure 5a, identify all the significant AND insignificant factors (write down the actual name of the factors) as well as interactions affecting the deviations to the response. (8 marks)  ii) What can the FYP student do to obtain a more accurate prediction model? (2 marks) | **Mark (10)** |
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|  | Word Count: 196 | Max Words: 250 |

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| **Q21:** | 5c) Figure 5b illustrates the main effects plot of the DOE study from Minitab Output. Which factor will produce the least AND the most changes affecting the response? Explain your reason. (3 marks)  C:\Users\17046589\AppData\Roaming\Republic Poly\eQuest\_assessmentimages\_assessmentimg_808502101_692572964.jpeg  Figure 5b: Main effects plot of the DOE study | **Mark (3)** |
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| **Q22:** | **Question 6 (10 marks)** 6a) Andon is a system to notify management, maintenance, and other workers of a quality or process problem. Explain how the Andon system helps to achieve Zero Defect Quality. (2 marks) | **Mark (2)** |
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| **Q23:** | 6b) Hospitals require different types of air functions for different purposes. Figure 6a shows the various pin index safety system (PISS) used in a hospital. Answer the below questions (i) to (iv).  C:\Users\17046589\AppData\Roaming\Republic Poly\eQuest\_assessmentimages\_assessmentimg_481313965_1154777338.jpeg  Figure 6a: Pin index safety system (PISS) used in a hospital  i) Describe how this PISS Poka-Yoke design works. (1 mark)  ii) Identify AND describe the mistake-proofing function of the Poka-Yoke design. (2 marks)  iii) What is the method used for the design to function? (1 mark)  iv) If all the pins are of the same design, state TWO possible types of human errors that may occur. Give an example each to explain your stated errors. (4 marks) | **Mark (8)** |
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| **Q24:** | **Question 7 (10 marks)** 7a) A company is utilizing both the “Kaizen approach” and “Innovation approach” for various improvement activities. Explain the main differences in term of involvement, advantage and timeframe between these two approaches. (3 marks) | **Mark (3)** |
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|  | Word Count: 43 | Max Words: 100 |

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| **Q25:** | 7b) For each of the below scenarios, identify whether “Kaizen approach” or “Innovation approach” is more suitable in making improvement for the company. Explain your reason.  i. The current road bike design has been well received by customers since it was launched last year. For the coming new road bike model to be launched next year, only minor enhancement will be made to the handle bars to improve ride comfort. (2 marks)  ii. As sales has been poor due to competitor’s new lighter road bike launch, the CEO of the company has assigned the research and development department to design a new breakthrough road bike that is only 500g in weight. (2 marks)  iii. The production manager mentioned that the defects have existed for months and the customer is getting impatient. The company management has pooled few “champions” to lead and initiate a Lean Six Sigma project to solve the problems within two weeks. (2 marks) | **Mark (6)** |
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| **Q26:** | 7c) A control plan is a document that identifies critical input or output variables and associated activities to maintain control of the variations. The control plan will not be maintained or updated once it has been developed and endorsed. Do you agree? (1 mark) | **Mark (1)** |
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|  | Word Count: 16 | Max Words: 100 |

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