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| **MATHEMATICS 3 PERIODS**  **PART B** |

**DATE:** Monday 30th January 2023

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| **DURATION OF THE EXAMINATION:**  **2 hours (120 minutes)**  **AUTHORISED MATERIAL:**  ● Examination with technological tool: Calculator Casio Graph 90+E, Numworks or TI-83 Premium CE Python in exam mode.  ● Pencil for the graphs  ● Formula booklet  **SPECIFIC INSTRUCTIONS:** |  |

● Answers must show the reasoning behind the results or solutions provided.

● Full marks will not be awarded if a correct answer is not accompanied by supporting evidence or explanations of how the results or the solutions have been achieved.

● When the answer provided is not the correct one, some marks can be awarded if it is evident that an appropriate method and/or a correct approach has been used.

**NUMBER OF EXAM DOCUMENTS: 2**

**EXAM DOCUMENTS:**

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| **EXAM PAPER** | **YES ⊠ NO** |
| **ANSWER BOOKLET** | **YES  NO ⊠** |
| **FORMULA BOOKLET** | **YES ⊠ NO** |

**NUMBER OF PAGES OF THE EXAM PAPER: 6**

*REMINDER: NO ANSWERS TO BE WRITTEN ON THE EXAM PAPER*

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**NAME OF PUPIL:** …………………………………

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| PART B | | | | |
| QUESTION B1 | | | Page 1/2 | Marks |
| Dry ice (solid state CO2) at a certain ambient temperature produces gas that can be easily spotted.  The famous chef Sebastianic intends to use 100 g of dry ice to produce a scenical effect for his last creation, a special dessert In order to understand how the dry ice behave, Sebastianic took several time the weight during sublimation of the sample: | |  | |  |
| |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | |  | Time in min (x) | 2 | 4 | 6 | 8 | 10 |  | |  | Dry ice weight in g (y) | 92 | 78 | 62 | 51 | 40 |  | | | | |  |
|  |  | | |  |
| a) | **Copy** on your paper the correct scatter plot of the data in the table choosing between the red and the blue one of the following diagram: | | | 2 marks |
|  |  | | |  |
|  |  | | |  |
| b) | **Give** the value of the linear correlation coefficient of the data and **explain** if such a value is indicating or not a linear dependency between the two variables. **Explain** why the linear correlation coefficient has a negative value. | | | 3 marks |
|  |  | | |  |
| c) | **Determine** an equation in the form of the linear regression of on using the data from the table.  **Give** the numbers and correct to two decimal places. | | | 3 marks |

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| PART B | | | |
| QUESTION B1 | | Page 2/2 | Marks |
| In questions d) and e), use the model . | | |  |
|  |  | |  |
| d) | **Use** the model to **calculate** how many grams of dry ice are still present after 13 minutes. **Explain** if this model has a good prediction for the dry ice weight after 20 minutes. | | 3 marks |
|  |  | |  |
| e) | **Use** the model to **calculate** when the dry ice is over. | | 3 marks |
|  |  | |  |
| The chef Sebastianic is satisfied of the dry ice results and adds to the menu the new dessert. In order to fulfill the demand, he needs to buy some dry ice.  The cost per kilogram of dry ice (in euros), years since the start of the year 2000 (the beginning of year 2000 corresponds to ), is well described by the function: | | |  |
| f) | Sebastianic bought 1 kg of dry ice at the beginning of 2023. **Determine** how much he paid. | | 2 marks |
|  |  | |  |
| The derivative function of the function f is  The function has only one stationary point. | | |  |
| g) | **Calculate** in which year the dry ice cost was the highest and **state** that cost in euros. | | 3 marks |
|  |  | |  |
| h) | **State** the years when the cost of the dry ice was increasing, and the years when it was decreasing. | | 3 marks |
|  |  | |  |
| i) | **Calculate** the values of and to state the variation rate of the dry ice cost in time, at the beginning of year 2008 and at the beginning of year 2020. **Determine** on which of those two years the price was lowering more quickly. | | 3 marks |

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| PART B | | | | |
| QUESTION B2 | | | Page 1/2 | Marks |
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| In the first part of this exercise, we study the cooking of an egg that has just been taken out from a refrigerator.  An egg is soft-boiled when its yolk reaches a temperature of exactly 45°C. | |  | |  |
|  | | | |  |
| In questions a), b) and c), we consider an egg of mass 60 g. The cooking time (in seconds) needed to have the yolk of this egg reach the temperature (in °C) is given by: | | | |  |
| a) | **Determine** how long it takes for this egg to be soft-boiled. **Round** to the nearest second. | | | 2 marks |
|  |  | | |  |
| b) | **Determine** the temperature of the yolk in this egg after it has boiled for 240 seconds. **Round** to the nearest degree. | | | 3 marks |
|  |  | | |  |
| c) | **Draw** the graph showing the cooking time as a function of the temperature in the yolk for this egg, for temperatures between 4°C to 45°C. | | | 4 marks |
|  |  | | |  |
| In question d), we consider an egg that is soft-boiled after a cooking time of 275 seconds. The following equality applies to the mass (in grams) of this egg: | | | |  |
| d) | **Determine** the mass of this egg. **Round** to the nearest gram. | | | 3 marks |

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| PART B | | | |
| QUESTION B2 | | Page 2/2 | Marks |
| Every morning in a week (7 days), a man is served exactly one egg. Each morning, the probability that the served egg is soft-boiled is , independently of other mornings.  We study the random variable defined as the number of soft-boiled eggs this man will be served during those 7 mornings. | | |  |
|  | | |  |
| e) | **Show** that follows a binomial distribution, and **give** its parameters. | | 2 marks |
|  |  | |  |
| f) | **Determine** the probability that this man was served only one soft-boiled egg during those 7 mornings. | | 3 marks |
|  |  | |  |
| g) | **Determine** the probability that this man was served soft-boiled eggs for at least 2 mornings in that week. | | 3 marks |
|  |  | |  |
| h) | We know that this man was served at least two soft-boiled eggs during this week. **Determine** the probability that he was served exactly three soft-boiled eggs during this week. | | 2 marks |
|  |  | |  |
| i) | **Determine** the expected value and the standard deviation of the variable . **Interpret** those values in the context. | | 3 marks |

**END OF THE EXAMINATION**