

# MATHEMATICS 3 PERIODS PART B

## RESERVE 1

**DATE:** 19 June 2023, morning

**DURATION OF THE EXAMINATION:**

2 hours (120 minutes)

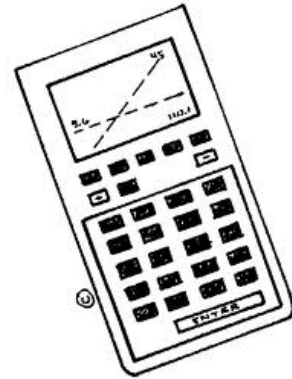
**AUTHORISED MATERIAL:**

Examination with technological tool:

Approved calculator

Pencil for the graphs

Formelsammlung/ Formula booklet/Recueil de formules



**SPECIFIC INSTRUCTIONS:**

Use a different page for each question.

- Answers must be supported by explanations.
- Answers must show the reasoning behind the results or solutions provided.
- If graphs are used to find a solution, they must be sketched as part of the answer.
- Unless indicated otherwise, 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 shown that an appropriate method and/or a correct approach has been used.

**EUROPEAN BACCALAUREATE 2023: Reserve MATHEMATICS 3 PERIODS**

<b>PART B</b>																															
<b>QUESTION B1</b>						<b>Page 1/2</b>	<b>Marks</b>																								
<p><b>Part 1</b> The table below shows the price of durum wheat in € per ton in the period 2016-2021.</p> <table border="1" style="width: 100%; border-collapse: collapse; margin: 10px 0;"> <thead> <tr> <th style="width: 20%;">Year</th> <th style="width: 5%;"></th> <th style="width: 10%;">2016</th> <th style="width: 10%;">2017</th> <th style="width: 10%;">2018</th> <th style="width: 10%;">2019</th> <th style="width: 10%;">2020</th> <th style="width: 10%;">2021</th> </tr> </thead> <tbody> <tr> <td>Years after 2016</td> <td><math>x</math></td> <td>0</td> <td>1</td> <td>2</td> <td>3</td> <td>4</td> <td>5</td> </tr> <tr> <td>Price of wheat (€ per ton)</td> <td><math>y</math></td> <td>110</td> <td>140</td> <td>145</td> <td>170</td> <td>266</td> <td>341</td> </tr> </tbody> </table> <p>a) <b>Draw</b> a scatter diagram to represent the data from the table. <span style="float: right;">2 marks</span></p> <p>b) <b>Determine</b> the average annual increase of the durum wheat price from 2016 to 2021. <span style="float: right;">1 mark</span></p> <p>c) <b>Determine</b> an equation in each of the forms <math>y = K \cdot A^x</math> and <math>y = K \cdot e^{ax}</math> of the exponential regression of <math>y</math> on <math>x</math> using the data from the table. Give the constants <math>A</math> and <math>a</math> correct to 3 decimals. <span style="float: right;">4 marks</span></p> <p>In d) and e) use the exponential model <math>g(x) = 104 \cdot e^{0.22x}</math> for the price in € per ton of durum wheat <math>x</math> years after 2016.</p> <p>d) <b>Estimate</b> the price of durum wheat in € per ton in 2023. <span style="float: right;">1 mark</span></p> <p>e) <b>Compare</b> <math>g'(4)</math> and <math>g'(5)</math>. <b>Explain</b> what these two values tell about the wheat price. <span style="float: right;">3 marks</span></p> <p><b>Part 2</b></p> <p>Two agricultural farms A and B produce wheat. Wheat harvests are brought to a processing site which transforms the wheat into semolina or flour and packs it into bags.                      40 % of the wheat used at the processing site come from farm A, and the rest comes from farm B.                      45 % of the wheat from farm A is used to produce flour.                      70 % of the wheat from farm B is used to produce semolina.                      At the processing site a bag is selected at random.</p> <p>f) <b>Calculate</b> the probability that the bag contains flour, and that the wheat came from farm A. <span style="float: right;">2 marks</span></p> <p>g) Given the bag contains semolina, <b>calculate</b> that the probability that the wheat came from farm B. <span style="float: right;">3 marks</span></p>								Year		2016	2017	2018	2019	2020	2021	Years after 2016	$x$	0	1	2	3	4	5	Price of wheat (€ per ton)	$y$	110	140	145	170	266	341
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PART B		
QUESTION B1	Page 2/2	Marks
<p><b>Part 3</b></p> <p>The region in which farm B is located is affected by septoria, a disease that affects different types of plants, including wheat. Farm B treats all its plots of wheat.</p> <p>Studies carried out in the region have made it possible to estimate that for wheat treated, 12 % is affected by this disease.</p> <p>We examine the wheat at 25 randomly selected check points on farm B.</p> <p>h) <b>Determine</b> the probability that at most one of these check points show wheat affected by this disease.</p> <p>i) <b>Determine</b> the expected number of check points showing this disease.</p>		<p>3 marks</p> <p>2 marks</p>
<p><b>Part 4</b></p> <p>The shaded region on the figure below shows a wheat plot on farm A. The region is bounded by the graph of the function <math>f</math> defined by <math>f(x) = -x^2 + 2x + 5</math> and the <math>x</math>-axis for <math>0 \leq x \leq 2</math>.</p> <div style="text-align: center;"> </div> <p>j) A function <math>F</math> is defined by <math>F(x) = -\frac{1}{3}x^3 + x^2 + 5x</math>.</p> <p><b>Show</b> that <math>F</math> is a primitive of <math>f</math>.</p> <p>k) <b>Calculate</b> the area of the shaded region.</p>		<p>2 marks</p> <p>2 marks</p>

PART B		
QUESTION B2	Page 1/2	Marks
<p><b>Part 1</b></p> <p>The electric car VOLTWAGEN is tested on a short, straight test track. The car finishes the test track in 8 seconds and the speed <math>v</math> (in m/s) of the electric car can be modelled by</p> $v(t) = -2t^2 + 16t ,$ <p>where <math>t</math> is the time in seconds, <math>0 \leq t \leq 8</math>.</p> <p>a) <b>Determine</b> <math>v'(t)</math> and <b>interpret</b> what the derivative means in this context. 3 marks</p> <p>b) <b>Calculate</b> <math>\int_0^8 v(t) dt</math> and <b>interpret</b> what the result means in this context. 3 marks</p> <p>c) <b>Calculate</b> the car's highest speed on the test track. 3 marks</p> <p><b>Part 2</b></p> <p>In 2018 the number of Volkswagens sold was 3325. The following years the number of cars sold increased by 8.2 % per year.</p> <p>d) <b>Calculate</b> the number of cars sold in 2022. 2 marks</p> <p>e) Consider the function <math>f</math>, where <math>f(x)</math> is the number of cars sold <math>x</math> years after 2018.  <b>Solve</b> the equation <math>f(x) = 5000</math>, and <b>interpret</b> the result. 3 marks</p> <p>f) <b>Determine</b> the doubling time, i.e. the time it takes for the number of cars sold to double. 3 marks</p>		

PART B		
QUESTION B2	Page 2/2	Marks
<p><b>Part 3</b></p> <p>The manufacturer claims that 90 % of the Volkswagens can go 700 km on one charge. A group of people using these cars suspects that the batteries are not that good. A research institute controls 80 randomly selected Volkswagens. The control shows that 66 of the 80 cars could go 700 km on one charge.</p> <p>To test the manufacturer's claim, the institute will conduct a hypothesis test at the 5 % significance level.</p> <p>g) <b>State</b> the null hypothesis <math>H_0</math> and the alternative hypothesis <math>H_1</math>. <span style="float: right;">2 marks</span></p> <p>h) <b>Explain</b> whether the test is left or right sided. <span style="float: right;">2 marks</span></p> <p>i) The random variable <math>X</math> describes the number of cars from a sample of 80 Volkswagens being able to drive 700 km on one charge of the battery. Assuming that <math>H_0</math> is true, <b>calculate</b> the probability that <math>X</math> is less than or equal to 66. <span style="float: right;">4 marks</span> Hence <b>conclude</b> whether the hypothesis <math>H_0</math> is rejected.</p>		