MATHEMATICS 3 PERIODS
PART B

DATE: 10th June 2024, morning

DURATION OF THE EXAMINATION:

2 hours (120 minutes)

AUTHORISED MATERIAL:

Examination with technological tool:

authorized 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.

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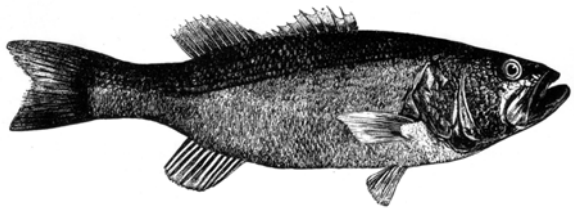
QUESTION B1	**Page 1/3**	**Marks**

Part 1



A population of black sea bass fish is introduced into a lake.

The number of fish in the lake is modelled by the function N defined by

$N(t) = 3500 \cdot e^{0.0862 \cdot t}$, $t \geq 0$,

where t is the time in days after the introduction.

a) **Interpret** the number 3500 in this context. — 1 mark

b) **Calculate** the number of fish in the lake after a week.
Give your answer to the nearest whole number. — 2 marks

c) **Rewrite** the formula for $N(t)$ in the format $N(t) = K \cdot A^t$. — 2 marks

d) **Determine** the percentage growth of the number of fish per day. — 2 marks

e) **Determine** after how many days the number of fish in the lake will have doubled. — 2 marks

f) **Explain** whether this model can be used over a long time. — 1 mark

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QUESTION B1	**Page 2/3**	**Marks**

Part 2

It is quite difficult to catch a blue marlin fish. They put up an intense fight when hooked.

In the year 2022, 5300 anglers from 300 000 anglers in total managed to catch a blue marlin.
In 2023, 149 anglers from a random sample of 7000 anglers managed to catch a blue marlin.
To determine whether the proportion of anglers catching a blue marlin has increased from 2022 to 2023, a hypothesis test is performed at a 5 % significance level.
Let p denote the proportion of anglers that succeeded in catching a blue marlin in 2023.

g) **Verify** that the null hypothesis for this test is $H_0 : p = 0.0177$. — 2 marks

h) **Determine** whether the test is left or right tailed. **Justify** your answer. — 2 marks

i) **Calculate** the probability that the number of anglers that succeeded in catching a blue marlin from a random sample of 7000 anglers is greater than or equal to 149, assuming that H_0 is true. — 5 marks

Decide whether H_0 can be rejected. **Justify** your decision.

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QUESTION B1	**Page 3/3**	**Marks**

Part 3

Adult salmon live in the open sea but return to the freshwater streams and rivers to lay their eggs. This is known as reproductive migration. Scientists started recording the migration in 2010.

The population of migrating salmon can be modelled by the function P defined by

$$P(t) = a \cdot \sin(0.5\,t) + d\,,$$

where t is the time in years after 2010.

In 2013 they recorded 48 000 migrating salmon, which was the highest population to migrate. In 2019 they recorded 17 000 salmon, which was the lowest population to migrate.

j) **Show** that the amplitude a of the function P is 15 500 and the vertical shift d is 32 500. — 2 marks

k) **Determine** the expected population of migrating salmon in 2024. — 2 marks

l) Salmon fishing is suspended when the population drops below 21 000**.**

Determine after how many years this is expected to happen for the first time since the recording started. — 2 marks

PART B

QUESTION B2	Page 1/3	Marks

Part 1

The following table shows the revenue *y*, in millions of euros, of a basketball league *x* years after 2006.

Year	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
x	0	1	2	3	4	5	6	7	8	9
y	34.1	43.1	49.5	59.3	59.4	60.9	76.9	86.6	90.8	97.8

a) **Represent** the above data on a scatter diagram. — 2 marks

b) Using the data from the table, **determine** an equation of the regression line of *y* on *x*. Give your answer to 3 decimal places.
Draw the regression line on the same diagram. — 3 marks

In the following use the model $y = 6.95 \cdot x + 34.56$.

c) According to the model, **estimate** the expected revenue for 2016. — 2 marks

d) A revenue of 114 million euros was generated in 2017 and 120 million euros in 2018.

Explain whether the above linear regression model seems appropriate after 2015. — 2 marks

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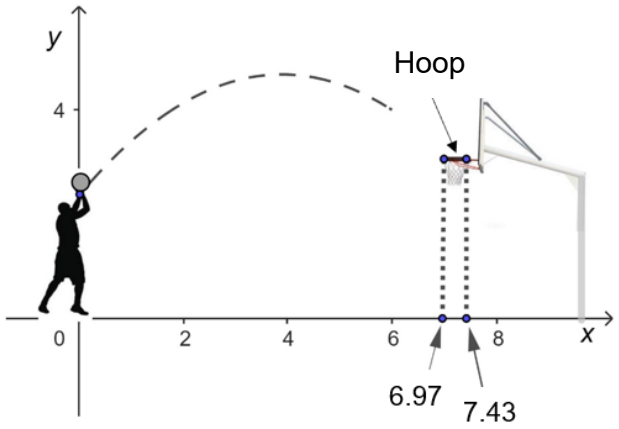
QUESTION B2	**Page 2/3**	**Marks**

Part 2



A successful shot in basketball can be achieved when the ball passes steeply and centrally through the hoop. In the following model it is assumed that the throw is directed towards the hoop. The trajectory of the lowest point of the ball is modelled by the function f defined by

$f(x) = -0.153x^2 + 1.19x + 2.36$,

where x is the horizontal distance from the release point (measured along the floor) in metres and $y = f(x)$ is the height in metres above the floor.

e) **Calculate** $f(0)$ and **interpret** the result. — 2 marks

f) The hoop is 3.05 metres above the floor. The horizontal distance from the release point to the nearest point of the hoop is 6.97 metres and to the furthest point it is 7.43 metres. The diameter of the ball is 24 cm.

Calculate $f(6.97)$ and $f(7.43)$. **Explain** whether the throw could be successful. — 3 marks

g) **Solve** the equation $f'(x) = -1$.

Interpret the result in the context of the trajectory of the ball. — 3 marks

h) **Determine** the length of the trajectory followed by the ball in reaching the point corresponding to a horizontal distance of 7.15 metres from the release point.

Use the arc length formula $\int_a^b \sqrt{1+(f'(x))^2}\,dx$. — 2 marks

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QUESTION B2	**Page 3/3**	**Marks**
Part 3 It is assumed that with each free throw Bob has an 87.7 % probability of scoring. i) Bob is going to take 10 free throws. **Calculate** the probability that Bob will score more than 8 times. j) **Determine** the number of free throws required for Bob to score more than 12 times with a probability of over 95 %.		3 marks 3 marks