Exercise 1 Calc. : ✓

Part 1

A company launched an online service in 2020, and has seen rapid growth in the number of subscribers each year. The company believes that the growth follows an exponential model S given by:

$$S(t) = 5000 \cdot e^{0.3 \cdot t},$$

where $S(t)$ is the number of subscribers t years after 2020.

a) **Write down** the number of subscribers the company had in 2020. — 1 mark

b) **Estimate** the number of subscribers there will be in 2025. — 1 mark

c) **Determine** the annual growth rate as a percentage. — 2 marks

d) The company aims to reach 100 000 subscribers. **Determine** in which year this is likely to be achieved. — 2 marks

Part 2

The same company has been tracking its annual advertising spending and corresponding revenue for several years. The data are given in the table:

Year	Advertising Spending, x, in thousands of euros	Revenue, y, in thousands of euros
2020	20.5	149.8
2021	25.3	181.7
2022	30.2	200.5
2023	35.4	239.3
2024	40.1	261.4

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

f) **Determine** the equation of the regression line for the data, in the form $y = mx + p$, with m and p rounded to two decimal places. **Draw** the regression line on the same diagram. — 3 marks

g) **Interpret** the value of the correlation coefficient r. — 2 marks

h) Using the model $y = 5.7x + 33.8$, **estimate** the revenue if the company spends 50 thousand euros on advertising. — 2 marks

i) **Interpret** in context the values 5.7 and 33.8. — 3 marks

Part 3

The company observes that the number of customer orders each month follows a normal distribution with mean $\mu = 1200$ orders and standard deviation $\sigma = 150$ orders.

j) **Determine** the probability that in a given month the company will receive between 1000 and 1350 orders. — 2 marks

k) **Determine** the probability that the company will receive more than 1300 orders in a given month. — 2 marks

l) In an advertisement, the company claims that it has at least 800 orders each month. **Examine** whether this claim is valid. — 3 marks

Exercise 2 Calc. : ✓

Part 1

Yoghurts are often considered part of a healthy diet. Unfortunately, not all yoghurts are healthy, because flavouring may have harmful additives.
A wholesaler buys yoghurts from two suppliers: 80% from supplier A and 20% from supplier B. 10% of yoghurts from supplier A have flavouring and 20% of those from supplier B also have flavouring.
For the following parts a), b) and c), a yoghurt is chosen at random from the wholesaler's stock.

a) **Determine** the probability that the yoghurt comes from supplier B and has flavouring. — 2 marks

b) **Show** that the probability that the yoghurt has no flavouring is 0.88. — 3 marks

c) Given that the yoghurt has flavouring, **determine** the probability that it comes from supplier B. — 2 marks

d) The wholesaler has a large stock and sells packages of 10 yoghurts selected at random.
Determine the probability that all 10 yoghurts in a package chosen at random have no flavouring. — 3 marks

Part 2

Milk is important for our health because it provides us with nutrients such as protein. A cow produces milk for approximately 10 months after giving birth. Milk production in litres per day from a cow of a certain breed is modelled by the function f defined by:

$$f(t) = -0.00068t^2 + 0.1831t + 24, \quad 0 \leq t \leq 300,$$

where t is the time in days after the cow gives birth.

e) **Determine** $f'(200)$. **Interpret** its meaning in context. — 3 marks

f) **Examine** whether milk production of 40 litres per day is possible for this cow. — 2 marks

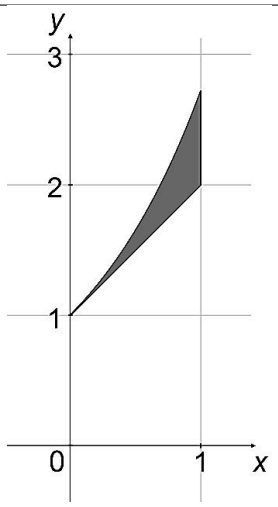
g) **Determine** for how many days milk production exceeds 30 litres per day for this cow. — 4 marks

Part 3

A yoghurt production company has a symbol designed by enclosing a region, shaded in the diagram, between the graphs of the functions g and h and the line $x = 1$, where:

$$g(x) = e^x$$

$$h(x) = x + 1.$$



h) **Show** that the graphs of the functions g and h intersect on the y-axis. 1 mark

One unit on the graph represents 1 metre.

i) **Calculate** in metres the perimeter of the region shaded in the diagram. 3 marks

Give your answer correct to 2 decimal places.

You may use the formula for the arc length L along a graph of f from $x = a$ to $x = b$:

$$L = \int_a^b \sqrt{1 + (f'(x))^2}\, dx.$$

j) **Determine** the area of the region shaded in the diagram in square metres. **Give** your answer correct to 2 decimal places. 2 marks