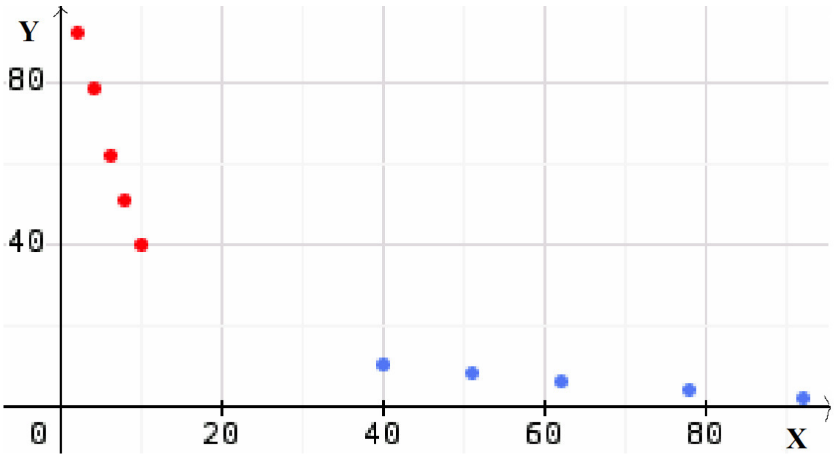
Exercise 1 Calc. : ✓

Dry ice (solid state CO_2) 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 $y = m \cdot x + b$ of the linear regression of y on x using the data from the table. — 3 marks

Give the numbers m and b correct to two decimal places.

In questions d) and e), use the model $y = -6.6 \cdot x + 104$.	
d) **Use** the model to **calculate** how many grams of dry ice are still present 3 marks 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 $f(x)$ per kilogram of dry ice (in euros), x years since the start of the year 2000 (the beginning of year 2000 corresponds to $x = 0$), is well described by the function: $$f(x) = (5 + x)e^{-0.12x} + 3$$	
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 $$f'(x) = (0.4 - 0.12x)e^{-0.12x}$$ The function f 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 $f'(8)$ and $f'(20)$ 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

Exercise 2 Calc. : ✓

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 45řC.

In questions a), b) and c), we consider an egg of mass 60 g. The cooking time $f(x)$ (in seconds) needed to have the yolk of this egg reach the temperature x (in řC) is given by:

$$f(x) = -16 \cdot 60^{2/3} \cdot \ln\left(\frac{100-x}{192}\right)$$

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 $f(x)$ as a function of the temperature x in the yolk for this egg, for temperatures between 4řC and 45řC. — 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 m (in grams) of this egg:

$$275 = -16 \cdot m^{2/3} \cdot \ln\left(\frac{55}{192}\right)$$

d) **Determine** the mass of this egg. **Round** to the nearest gram. — 3 marks

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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 $p = 0.65$, independently of other mornings.
We study the random variable X defined as the number of soft-boiled eggs this man will be served during those 7 mornings.

e) **Show** that X 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 X. **Interpret** those values in the context. — 3 marks