

<b>Part D</b>	Problems 17-25 which require complete solutions.
<b>Test time</b>	120 minutes.
<b>Resources</b>	Digital resources, formula sheet and ruler.

**Level requirements**

The test consists of an oral part (Part A) and three written parts (Part B, Part C and Part D). Together they give a total of 72 points of which 26 E-, 25 C- and 21 A-points.

Level requirements for test grades

E: 19 points

D: 29 points of which 8 points on at least C-level

C: 38 points of which 15 points on at least C-level

B: 48 points of which 7 points on A-level

A: 57 points of which 12 points on A-level

The number of points you can have for a complete solution is stated after each problem. You can also see what knowledge level(s) (E, C and A) you can show in each problem. For example (3/2/1) means that a correct solution gives 3 E-, 2 C- and 1 A-point.

For problems labelled “*Only answers required*” you only have to give a short answer. For other problems you are required to present your solutions, explain and justify your train of thoughts and, where necessary, draw figures and show how you use your digital resources.

**Write your name, date of birth and educational program on all the sheets you hand in.**

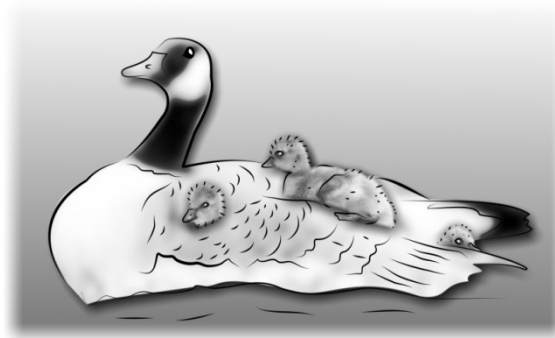
Name: _____
Date of birth: _____
Educational program: _____



**Part D:** Digital resources are allowed. Write your solutions on separate sheets of paper.

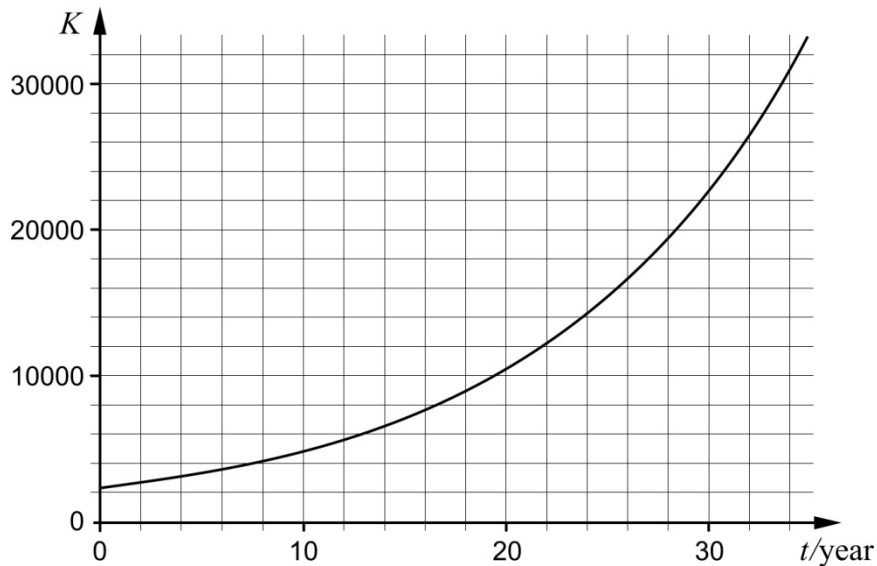
17. Determine for what value of  $x$  the derivative of  $f(x) = x^2 + 5x$  is equal to the derivative of  $g(x) = -5x^2 + 14x$  (2/0/0)

18.



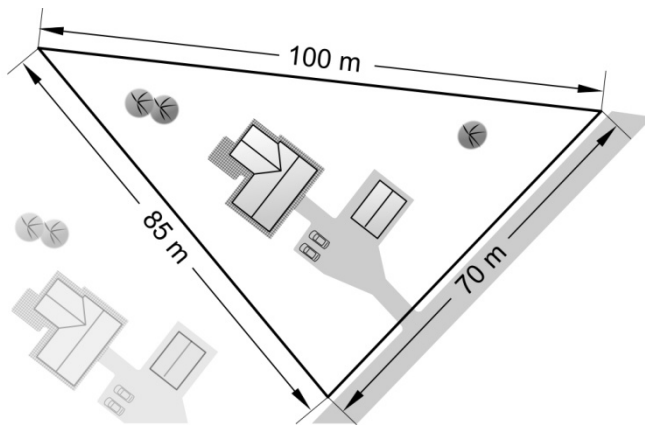
The Canada Goose was introduced into Sweden in the 1930s. The population has increased ever since. Every year, at the same time, there is a survey of the number of Canada Geese. The growth of the population can be described by an exponential model.

The diagram below shows the number of Canada Geese  $K$  as a function of time  $t$  years, where  $t = 0$  corresponds to the year 1977.



- a) Use the graph and determine an approximate value of  $K'(30)$  (1/0/0)
- b) Interpret what  $K'(20) = 800$  means to the number of Canada Geese in this context. (0/1/0)

19. The figure shows a building site with sides which have lengths of 100 m, 70 m and 85 m. Calculate the area of the site. (2/1/0)



20. The equation of a circle is  $x^2 - 2x + y^2 - y = 0.5$
- a) Does the point (1, 2) lie on the circle? Justify your answer. (2/0/0)
- b) The circle has its centre at (1, 0.5). Calculate the area of the circle. (0/3/0)

21. Are the following statements correct? Justify your answers.

- a)  $F(x) = 3e^x$  is an antiderivative of  $f(x) = e^{3x}$  (1/0/0)
- b) The graph of  $f(x) = x^3 + ax$  has three different zeroes if the constant  $a \leq 0$  (0/2/1)

22. Karolina pours a cup of coffee in a room where the temperature is  $20^\circ\text{C}$ . She immediately measures the temperature of the coffee and continues to do so every minute during the first 5 minutes. Karolina then adjusts a mathematical model to her measurements:

$$T(t) = 95e^{-0.039t}$$

where  $T$  is the temperature of the coffee in  $^\circ\text{C}$  and  $t$  is the time in minutes after Karolina started measuring the temperature.

- a) Determine the temperature of the coffee when Karolina started to measure. (1/0/0)
- b) Determine by what percentage the temperature of the coffee decreases each minute. (0/1/0)
- c) Karolina's model corresponds well with reality in the beginning. Evaluate how well her model corresponds with reality over time. (0/1/1)

23.



Tartaglia (1500-1557)

The Italian Tartaglia was a mathematician who lived in the 16th century. He is considered to have formulated the following mathematical problem, here in a modern translation:

*The sum of two positive numbers is 8. Determine the numbers so that the product of the difference of the numbers and the product of the numbers is as large as possible.*

Your task is to solve Tartaglia's mathematical problem. (0/0/3)

24. It holds for the cubic function  $f$  that

- $f'(2) = -1$
- $f''(4) = 0$

Determine  $f'(6)$  (0/0/3)

25. When Mario was born, his grandmother decided to save money for him in a jar. Her plan is to put in an amount corresponding to the square of Mario's age multiplied by 100 in the jar every time it is his birthday. Mario's uncles Sergio and Riccardo think about how much money there will be in the jar on Mario's sixth birthday.

Sergio says: *You can find out how much money there will be in the jar by*

*calculating the integral  $\int_0^6 100x^2 dx$*

Riccardo thinks for a while and replies: *No, it gives too small a value.*

Explain why the above integral gives a too small value if it is used to calculate how much money there will be in the jar on Mario's sixth birthday. (0/1/3)