Part D	Problems 17-24 which require complete solutions.
Test time	120 minutes.
Resources	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 65 consisting of 23 E-, 23 C- and 19 A-points.

Level requirements for test grades
E: 17 points
D: 26 points of which 8 points on at least C-level
C: 34 points of which 14 points on at least C-level
B: 44 points of which 6 points on A-level
A: 53 points of which 11 points on A-level

The number of points you can get for a complete solution is stated after each problem. You can also see what knowledge levels (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 answer is 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 thought and, where necessary, draw figures and show how you use your digital resources.

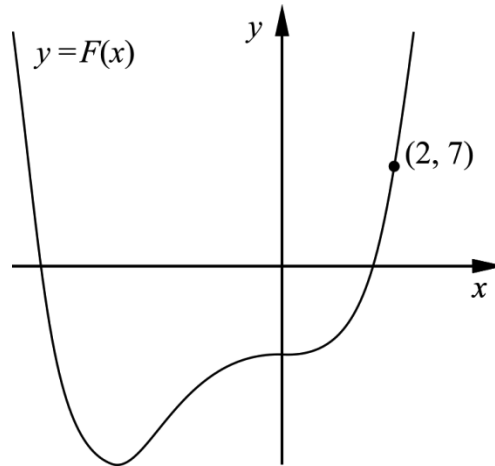**Write your name, date of birth and educational programme on all the sheets you hand in.**

Name: _____

Date of birth: _____

Educational programme: _____

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

17. It holds for the function f that $f(x) = x^3 + 3x^2$
    F is an antiderivative of f The graph of F passes through the point $(2, 7)$.
    See figure.

    Find the antiderivative F. (2/0/0)

18. Hugo solves the equation $|x + 2| + 0.5x = 5$ and gets the solution $x = 2$
   His friend Lisa claims that $x = -12$ is also a solution to the equation.

    Is Lisa right? Justify your answer. (1/0/0)

19. The temperature of the water in a bottle placed in a fridge can be described
    by the model $T(x) = 17e^{-0.693x} + 5$
    where $T(x)$ is the temperature of the water in $°C$ and x is the time in
    hours after the bottle was placed in the fridge.

    a) Calculate the temperature of the water when the bottle was placed in
       the fridge. (1/0/0)

    b) Determine how long it takes until the temperature of the water is
       $10°C$. (2/0/0)

    c) Determine how rapidly the temperature of the water is decreasing two
       hours after the bottle was placed in the fridge. (0/2/0)

    d) According to the model, the temperature will, in time, approach a
       lower limit. Use the model to calculate this lower limit. (0/2/0)

2

20. The graph of $f(x) = x^4 - 4x$ has a tangent at the point P.
The tangent has the gradient -17.5
Find the x-coordinate of the point P. (0/2/0)

21. Two boats leave a harbour at the same time. Both boats keep a constant speed. Boat A has a speed of 50 km/h and boat B has a speed of 36 km/h. Both boats keep their course straight so that the angle between their directions of travel always is $52°$.
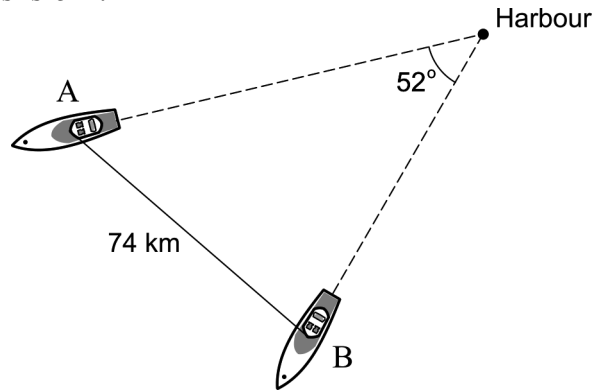
The boats have radio contact with each other. When the distance between them is 74 km, the contact is lost. Assume that it takes t hours before the contact is lost. Calculate the time t. (0/3/0)

22. Two squares of different size are placed according to the following conditions:

- The squares should each have one of their corners at the same point P.
- The squares should not have any other points in common.

Two lines are drawn between the corners of the squares so that two triangles are formed outside the squares. The figure below shows *one* example of what it might look like.
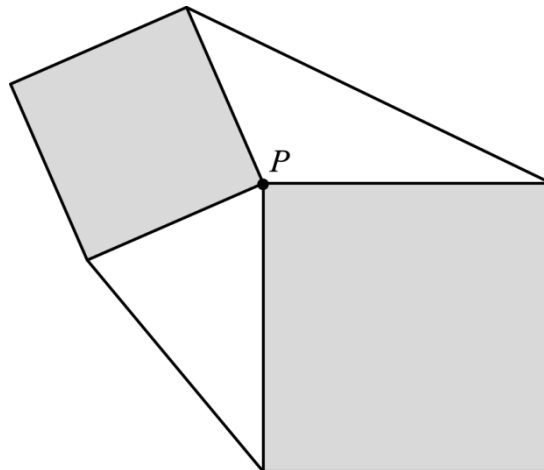
Prove that the area of one of the triangles is always equal to the area of the other triangle. (0/0/3)

3

23. The bacterium *Clostridium perfringens* may cause serious food poisoning. If food containing this bacterium is left to cool down at room temperature, the number of bacteria increases. Therefore, food should always be cooled as quickly as possible after cooking. It takes approximately 100 000 bacteria per gram of food for a person to get food poisoning.

Assume that immediately after cooking, there are 100 bacteria per gram in a piece of cooked salmon. The cooked salmon is cooled at room temperature.

The number of bacteria increases at a rate of $5.73e^{0.0573 \cdot t}$ bacteria per gram per minute at the time t minutes.

How long does it take before there are so many bacteria per gram in the salmon that a person eating from it will risk getting food poisoning? (0/0/4)

24. Sara sells bilberries at the local market. She has found out that every time she increases the price with SEK 1/kg the amount of bilberries she sells per day decreases by 2 %. If she sets the price at SEK 40/kg, she will sell 30 kg per day.

a) Calculate the daily income SEK D as a function of the price increase x in SEK/kg, where $0 \leq x \leq 60$

Only answer is required (0/0/2)

b) Use the function in the a) task and draw the graph. Use the graph to determine what price per kilo will yield the largest daily income. (0/0/1)