Part D	Problems 16-24 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 7 points on at least C-level
C: 33 points of which 13 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 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 thought and, where necessary, draw figures and show how you use your digital resources.
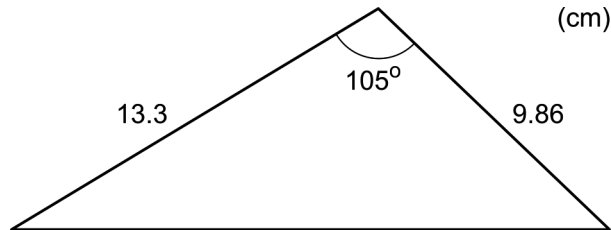
Write your name, date of birth and educational programme on all the sheets you hand in.

Name: _____

Date of birth: _____

Educational programme: _____

Part D: Digital resources are allowed. Do your solutions on separate sheets of paper.
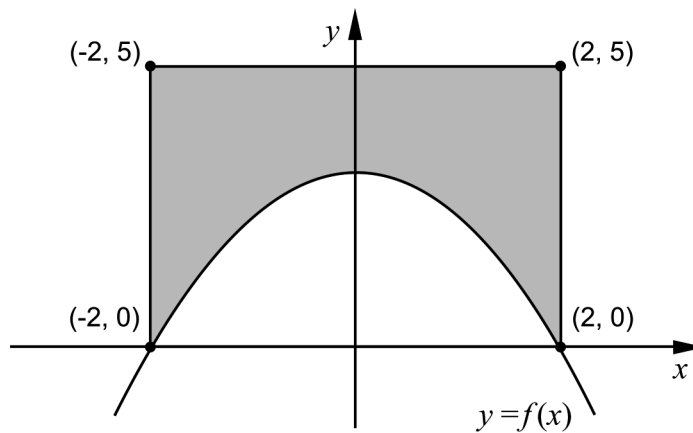
16. Determine the values of x for which it holds that the graph of
$f(x) = x^3 - 0.88x$ has the gradient 5 (2/0/0)

17. Calculate the area of the triangle.

(cm)

105°

13.3   9.86

(2/0/0)

18. The figure below shows the graph of $f(x) = -0.75x^2 + 3$ and a rectangle. The rectangle has its corners at the points (–2, 0), (–2, 5), (2, 0) and (2, 5).

a) Use the figure and explain, in words, why $\int_{-2}^{0} f(x)\,dx = \int_{0}^{2} f(x)\,dx$ (1/1/0)

b) Calculate the area of the shaded region. (2/1/0)

3

19. Anton and Anya want to know the distance between two spots in the forest, *A* and *B*. It is hard to move between these spots. Therefore, it is difficult for them to measure the distance directly.

Instead they choose two spots *C* and *D* that together with *B* are situated along the same line. Anton and Anya then measure the distances *AC*, *AD*, *BD* and *CD*, see figure. The figure is not drawn to scale.
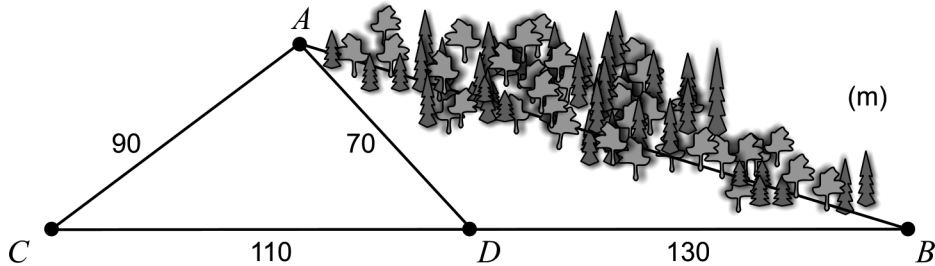
Calculate the distance from *A* to *B*. (0/3/0)

20. Today there are approximately 7 billion people on Earth. A model that describes the number of people on Earth as a function of time is

$$N(t) = \frac{11}{1 + 3.4e^{-0.03 \cdot t}}$$

where *N* is the number of people in billions and *t* is the time in years after 1950.

a) Calculate the number of people on Earth in 1950. (1/0/0)

b) According to the model, the number of people on Earth will in time reach an upper limit. Use the model and determine this upper limit for the number of people. (0/3/0)

21. It holds for a function *f* that $f(x) = (x - a)(x - b)$ where *a* and *b* are constants. Find the relation that must be true for *a* and *b* in order for the graph of *f* to have a tangent with gradient 2 when $x = 4$ (0/3/0)

22. It holds for the polynomial function f that $f'(x) > 0$ for all x.
Investigate how many real solutions there are to the equation $f(x) = 0$ (0/0/2)

23. Albin's weight can be described by the function

$$V(t) = 0.10t^3 - 1.23t^2 + 6.51t + 3.72$$

where the weight V kg is a function of the time t years after his birth. The function is true for his first eight years in life.

The rate of increase of Albin's weight varies. Calculate what values the rate of increase can have during the first eight years of Albin's life.   (0/0/2)

24. The bacterium *Clostridium perfringens* can cause severe food poisoning. If food containing this bacterium is allowed to cool at room temperature, the numbers of bacteria increases. Therefore, food should always be cooled down quickly after cooking. It takes about 100 000 bacteria per gram of food for a person to get food poisoning.

Assume that there are 100 bacteria per gram of cooked salmon after it has been cooked. The cooked salmon is allowed to cool 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 of salmon that a person eating it risks getting food poisoning?   (0/0/4)

5