Part B	Problems 1–8 which only require answers.
Part C	Problems 9–18 which require complete solutions.
Test time	150 minutes for Part B and Part C together.
Resources	Formula sheet and ruler.

Level requirements

The test consists of three written parts (Part B, Part C and Part D).
Together they give a total of 61 points consisting of
21 E-, 23 C- and 17 A-points.

Level requirements for test grades
E: 15 points
D: 24 points of which 7 points on at least C-level
C: 31 points of which 13 points on at least C-level
B: 41 points of which 5 points on A-level
A: 49 points of which 9 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.

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

Name: ______________________________

Date of birth: ______________________________

Educational programme: ______________________________

Part B: Digital resources are not allowed. *Only answer is required*. Write your answers in the test booklet.

1. It holds for the function f that $f(x) = \sin 2x$.

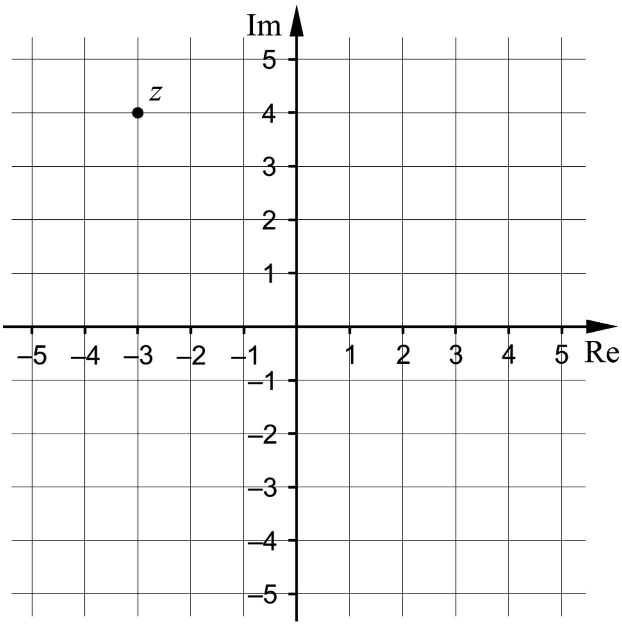
a) Find $f(\frac{\pi}{6})$. ______________________ (1/0/0)

b) Find $f'(x)$. ______________________ (1/0/0)

2. Write down the vertical asymptotes of $f(x) = \dfrac{1}{x^2 - 4}$

______________________ (2/0/0)

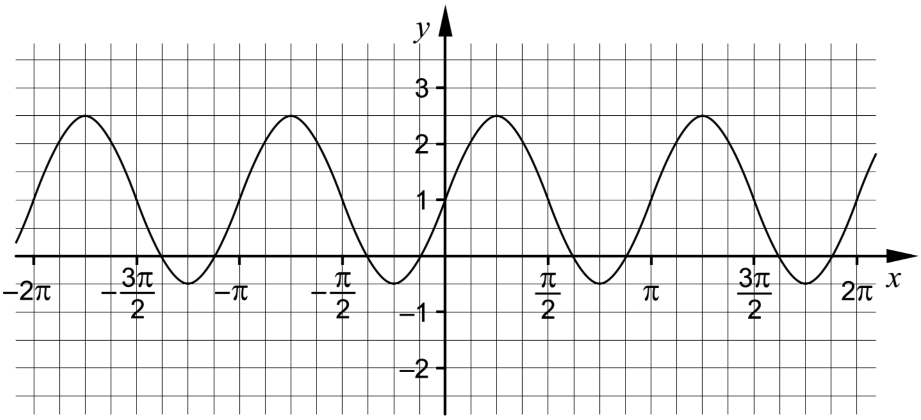
3. The figure shows a complex plane where the number z has been marked.



a) Find $\bar{z}$. ______________________ (1/0/0)

b) Find $|z|$. ______________________ (1/0/0)

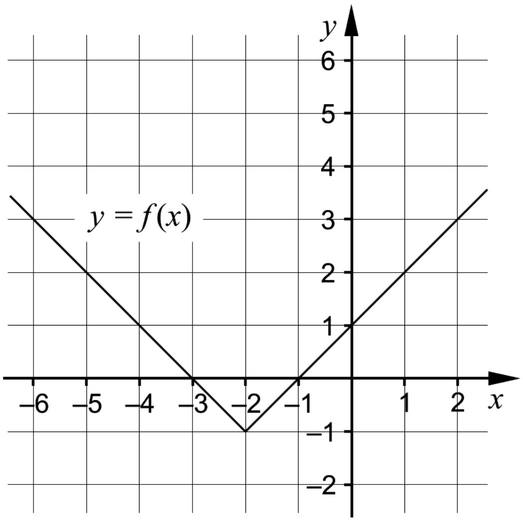
4. The figure shows a sine curve.



Find the equation of the sine curve in the form $y = A\sin(kx) + B$.

$y =$ ______________________ (1/1/0)

5. The figure shows the graph of $f(x) = a + |x + b|$.

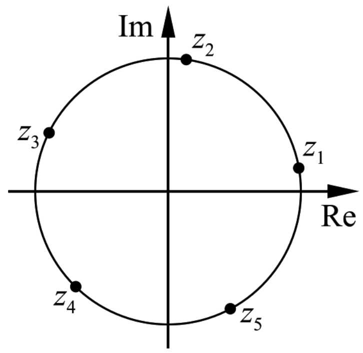


Find the constants a and b.

$a =$ ______________________

$b =$ ______________________ (1/1/0)

6. The figure shows the circle $|z| = 1$ in the complex plane. The five roots z_1, z_2, z_3, z_4 and z_5 of the equation $z^5 = \cos 50° + i \sin 50°$ are marked on the circle.



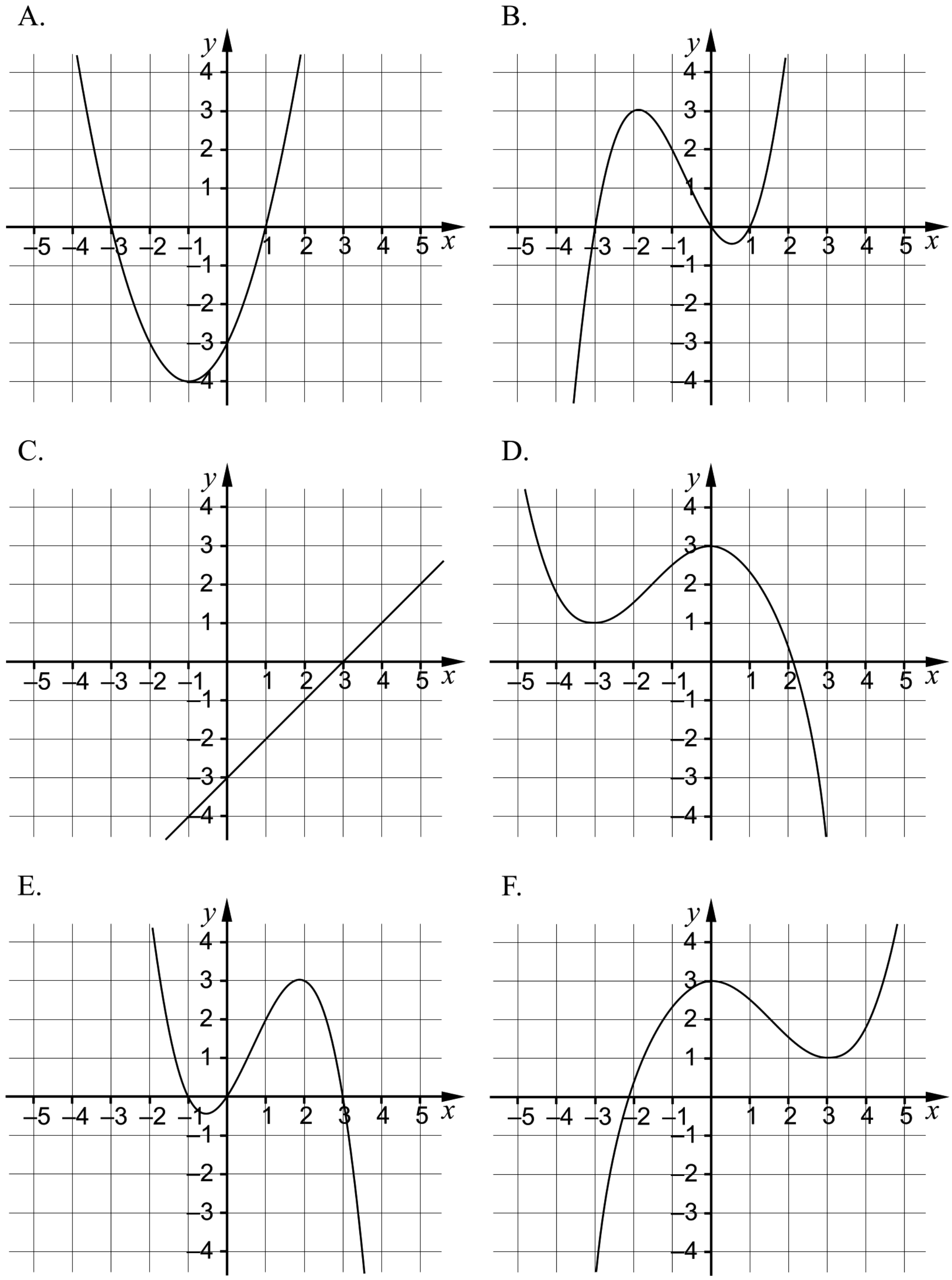
a) Find $\arg z_1$ ______________________ (1/0/0)

b) Find $\arg z_3$ ______________________ (0/1/0)

7. Chen is going to differentiate the function f. He sees that the function is a product. Chen differentiates the function and gets the correct answer $f'(x) = 2x \cdot \sin x + x^2 \cdot \cos x$.

Find the function f. ______________________ (0/1/0)

8. The figures A–F show the graphs of six different polynomial functions.



Two of the figures A–F show the graphs of polynomial functions that are divisible by $x+3$
Which two? ______________________ (0/0/1)

Part C: Digital resources are not allowed. Do your solutions on separate sheets of paper.

9. Show that $\dfrac{\sin 2x}{2\cos x} = \sin x$ for all x where the expressions are defined. (2/0/0)

10. Solve the equation $\sin 3x = \dfrac{1}{2}$. Give the answer in degrees. (2/1/0)

11. In the two complex numbers $z_1 = a + a\,\mathrm{i}$ and $z_2 = (a+1) + (a-1)\,\mathrm{i}$
the constant a is a real number and $a > 0$
Show that $|z_1| < |z_2|$. (0/2/0)

12. The equation $x^2 + ax + b = 0$ has one root $x = 1 + \mathrm{i}\sqrt{3}$
Determine the real constants a and b. (0/3/0)

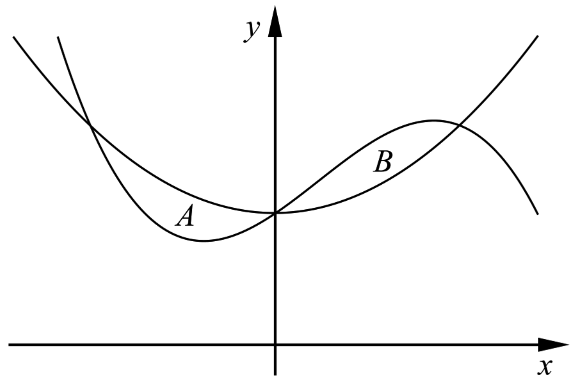
13. One solution to the equation $z^3 + 2z^2 + 5z + 10 = 0$ is $z = -2$
Determine the remaining solutions to the equation. (0/2/0)

14. Investigate how the number of solutions to the equation $B\sin 2x = 5$ on the interval $0 \le x < 2\pi$ depends on the value of the constant B.
Justify that the equation has the number of solutions you claim for the different values of B. (0/2/1)

15. Determine the constant a so that $\displaystyle\int_2^4 \left(\frac{1}{x+2} + \frac{1}{x}\right) \mathrm{d}x = \ln a$. (0/1/1)

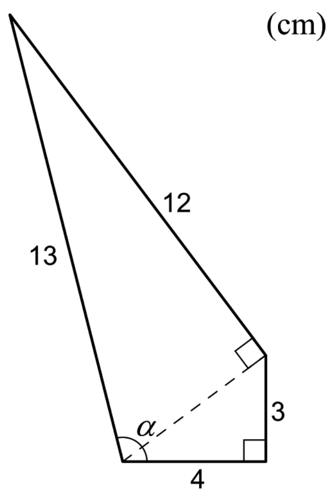
16. Solve the equation $|z|^2 = 5z - 10\,\mathrm{i}$. (0/0/3)

17. It holds for the functions f and g that $f(x) = x^2 + 3$ and $g(x) = -x^3 + x^2 + kx + 3$, where $k > 0$
The graphs of the functions f and g enclose the regions A and B, see figure.



Show that the area of A is equal to the area of B regardless of the value of k. (0/0/4)

18. The figure shows a quadrangle divided into two right-angled triangles.



One of the angles in the quadrangle is denoted α.
Determine $\sin\alpha$. (0/0/2)