

1. exercise sheet for Mathematics for advanced materials science

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(first name)	(last name)
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(student id number)	

1.1. (Linear ordinary differential equations) (4 credits)

(a) Find a function $x : \mathbb{R} \rightarrow \mathbb{R}$ solving the differential equation $\ddot{x} + \dot{x} + x = 0$ and satisfying $x(0) = 0$ and $\dot{x}(0) = 1$. (Hint: you may test your solution for correctness by verifying, using a calculator, that $x(1) \approx 0.533507$.)

(b) Find *two different* solutions $x : \mathbb{R} \rightarrow \mathbb{R}$ to the differential equation $\ddot{x} + \dot{x} + x = 0$ with $x(0) = 1$.

1.2. (Computing with complex numbers) (4 credits)

Write the following complex numbers in the form $a + ib$ with real numbers a and b .

(a) $\frac{1}{2+i} = \boxed{} + i \boxed{},$

Please submit your solutions digitally at the corresponding TeachCenter course. The deadline is 12.10.2021, 23:55 o'clock. <https://tc.tugraz.at/main/course/view.php?id=3543>
<https://www.math.tugraz.at/~mtechnau/teaching/2021-w-mams.html>

(b) $\frac{2+4i}{1+3i} - 2+i = \boxed{} + i \boxed{},$

(c) $\left| \frac{1}{2+i} \right| = \boxed{} + i \boxed{},$

(d) $\sqrt{3+4i} = \boxed{} + i \boxed{}.$

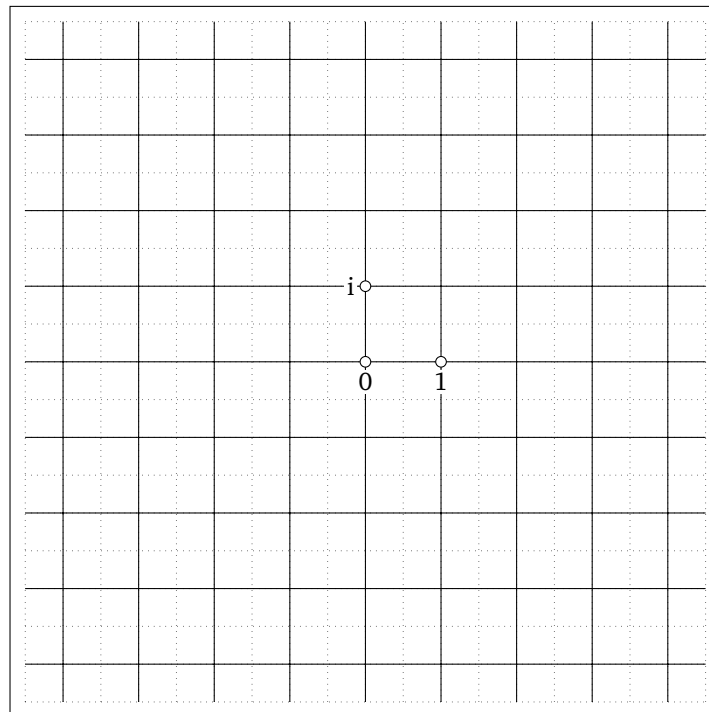
(Hint for (d): find two complex numbers $z = a + ib$ with $z^2 = 3 + 4i$.)

1.3. (Solving quadratic equations) (4 credits)

Find all (complex) solutions to the equation $X^2 - 2X + 3 \stackrel{!}{=} 0$. (Hint: you can use the formula for finding roots of quadratic polynomials. Use $\sqrt{-1} = \pm i$.)

1.4. (Working with complex numbers) (4 credits)

Sketch the following set of complex numbers below: $\{z \in \mathbb{C} : 1 \leq |z| < 4, \operatorname{Re}(z) \geq -2\}$.



Note: this exercise sheet (like any other with an odd number) will not be discussed during class. You are expected to just provide answers to the questions above, but without explaining which calculations have led you to your answer.