

# Short Test topics

This list contains the topics of each Short Test, and the actual questions that were on the classes.

- You can retake  $\leq 3$  of these, of your choice, on the last class (14 May).
- Please send me which tests you want to retake *until 13 May*.
- Each retaken test will replace the original score (for better or worse).
- The retake tests will be from the same topic, but *not necessarily the same kind of question*.

**1. (20 Feb)** Basic properties of sets; basic set operations.

Left:  $A = \{a, b\}$ ,  $B = \{A, \{b, e, d\}, \emptyset\} \longrightarrow \cup B = ?$ ,  $\{a, b\} \in \cup B ?$

Right:  $A = \{x, y\}$ ,  $B = \{A\} \cup \{x, y\} \cup \{x, \{y\}\} \longrightarrow B = ?$ ,  $\{\{x, y\}\} \subseteq B ?$

**2. (27 Feb)** Proving/disproving set statements; symmetric difference.

Left: Is it true for all  $A, B$  sets that  $A \setminus (A \setminus B) = A \cap B$ ?

Right: Is it true for all  $A, B$  sets that  $(B \setminus A) \cup A = A \cup B$ ?

**3. (5 Mar)** Relation basics; composition.

Left:  $R = \{(2, 3), (2, 4), (3, 2), (4, 1)\}$ ,  $S = \{(1, 2), (2, 3), (3, 1)\} \longrightarrow R \circ S = ?$

Right:  $R = \{(1, 3), (2, 1), (3, 2)\}$ ,  $S = \{(1, 2), (1, 3), (2, 1), (4, 3)\} \longrightarrow S \circ R = ?$

**4. (12 Mar)** Properties of relations (reflexive etc.).

Left:  $X = \{1, 2, 3\}$ ,  $R \subseteq X \times X$ ,  $R = \{(1, 1), (1, 2), (2, 2), (2, 3), (3, 2), (3, 3)\}$ .

Is  $R$  reflexive? Is  $R$  antisymmetric?

Right:  $X = \{1, 2, 3, 4\}$ ,  $R \subseteq X \times X$ ,  $R = \{(1, 2), (2, 1), (2, 2), (2, 4), (3, 3), (4, 2)\}$ .

Is  $R$  irreflexive? Is  $R$  symmetric?

**5. (19 Mar)** Equivalence relations; partitions.

Left:  $X = \{1, 2, 3\}$ ,  $R = \{(1, 1), (1, 2), (1, 3), (2, 1), (2, 2), (3, 3)\}$ .

Is  $R$  an equivalence relation?

Right:  $X = \{a, b, c, d\}$ ,  $R = \{(a, a), (a, c), (b, b), (c, a), (c, c), (d, d)\}$ .

What is the partition for this equivalence relation?

**6. (26 Mar)** Partial/total orders; minimal/maximal, least/greatest elements; functions; function properties (injective etc.).

Left:  $f : \mathbb{R} \rightarrow [0, \infty)$ ,  $f(x) = |x|$ .

Is  $f$  injective, surjective, bijective?

Right:  $A = \{1, 2, 3, 4\}$ ,  $B = \{1, 2, 3\}$ ,  $f \subseteq A \times B$ ,  $f = \{(1, 2), (2, 3), (3, 1), (4, 2)\}$ .

Is  $f$  a function? If so, is it injective?

**7. (9 Apr)** Complex numbers: algebraic form; equation solving; converting to polar form.

Left: Convert to polar form:  $z = \sqrt{3} + i$ .

Right: Convert to polar form:  $z = 1 - i$ .

**8. (23 Apr)** Complex numbers: drawing sets; geometric transformations.

Left: Draw  $\{z \in \mathbb{C} \mid |z - i| \leq 2 \wedge \text{Im}(z) \geq 0\}$  on the Gaussian plane.

Right: Draw  $\{z \in \mathbb{C} \mid 1 \leq |z + 1| \leq 2\}$  on the Gaussian plane.

**9. (30 Apr)** Basic combinatorics (Combinatoris I).

Left: How many outcomes are possible when rolling a die 4 times if

a) order matters; b) order doesn't matter?

Right: How many 4-digit numbers can be formed from the digits

a) 1,2,3,4,5,6,7; b) 0,1,2,3,4; if each digit can be used only once?

**10. (7 May)** More advanced combinatorics (Combinatoris II, ~first page).

Left: From 10 blue and 10 red balls (each are different), how many ways can we choose 5 balls so that at least one of them is blue?

Right: When rolling a die 5 times, how many outcomes are possible which contains one or more even numbers?