RWTH Aachen **WS 2018**
Lehrgebiet Theoretische Informatik Exam 1
Dreier—Kuinke—Rossmanith 18.02.2018

Parameterized Algorithms Exam

First name: **Mat. number:**
Last name: **Course of study:**

Partial solutions will be credited, so do not give up if you cannot provide the complete solution.

Exercise 1 (10 Points)

Show that the following problem is in FPT.

Input:	A graph G with maximal degree four and an integer k.
Parameter:	The integer k.
Question:	Does G contain an independent set of size k?

Exercise 2 (10 Points)

Prove that the following problem is in FPT by reducing to a problem kernel.

Input:	A set of n points in the plane $\mathbf{R}^2$, an integer k.
Parameter:	The integer k.
Question:	Can the points be covered by at most k straight lines?

Hint: What can you say about a line that covers more than $k + 1$ points?

Exercise 3 (12 Points)

Consider the following Problem.

Input:	A planar graph G and a graph connected graph H.
Parameter:	The number of vertices of H.
Question:	Is there a subgraph of G which is isomorphic to H?

a) Show that the problem is in FPT.

b) Show that the problem probably does not admit a polynomial kernel.

Hints: Every planar graph with radius r has treewidth $O(r)$. Hamiltonian cycle is NP-complete on planar graphs.

Exercise 4 (12 Points)

Is the following problem in FPT?

Input:	A graph G and an integer k.
Parameter:	The integer k.
Question:	Does G contain a clique of size k which has at most k neighbors?