

DIFFERENTIAL TOPOLOGY
PROBLEM SHEET 8

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Problem 1 (10 points, de Rham cohomology of \mathbb{R}^2). Compute $H_{dR}^k(\mathbb{R}^2)$, for all non-negative integers k .

Problem 2 (10 points, de Rham cohomology of $\mathbb{R}^2 \setminus \{(0, 0)\}$). Compute $H_{dR}^k(\mathbb{R}^2 \setminus \{(0, 0)\})$.

Problem 3 (10 points, cotangent bundle). Prove that the cotangent bundle of a smooth manifold has a smooth differential structure.

Problem 4 (20 points, Theorem 3.49). Prove that the map D_U in Step 3 of the proof of Theorem 3.49 is an exterior derivative on U and prove that there is an exterior derivative on M , see Step 5.

Date: Please hand in before the lecture by **07th of April 2023**. For all exercises the results need to be proven using results from this lecture and the lectures before, provided you give a reference.