

### Expectations for Exercises

Exercises are an important part of the Geophysics lecture. They will treat some aspects of the lecture in more detail, but also cover new ground. We expect that you work on the exercises at home and we will discuss questions and solutions interactively together. Questions that are marked with 'Extra' are not required but geared to stir your further interest. We will surely support you if you tackle those as well.

## 2 Exercises for Magnetism 1

**Version:** May 3, 2022

**Context:** Magnetism 01

**Timing:** All magnetism exercises should be completed by Thursday in week 5.

### 2.1 The magnetic dipole field

Derive the two-dimensional dipole field  $\vec{B}$  and its magnitude  $|\vec{B}|$  from the potential field using:

$$\begin{aligned}\vec{B} &= -\nabla A \\ &\approx -\nabla \frac{|\vec{m}| \cos(\theta)}{r^2}\end{aligned}$$

and show that

$$|B| = \frac{|\vec{m}|}{r^3} \sqrt{(3 \cos^2(\theta) + 1)}$$

. Also show that:

$$\nabla \cdot \vec{B} = 0.$$

Discuss what this means in terms of the magnetic dipole field. Be aware that the gradient  $\nabla$  and that the divergence  $\nabla \cdot$  have a specific form in polar coordinates which you should look up. No need to memorize the specific form of these operators in different coordinate systems, but remember that they differ from coordinate system to coordinate system.

### 2.2 The Earth's magnetic field

Use online resources and characterize the Earth's magnetic field in Tübingen in terms of (declination, inclination, horizontal component, total field strength etc.). Can you find information about temporal variability? How large is it and over which time frame? Visualize the time series. Post values and graphics in the forum.

### 2.3 Preparation for report writing

Read the document `Geophysics_Report_Suggestions` provided under general documents on Ilias. Provide feedback from other report-writing experiences if you have any.