

National Exams December 2019

18-Geol-B10-1, Gravity and Magnetism Fields

3 hours duration

NOTES:

1. If doubt exists as to the interpretation of any question, the candidate is urged to submit with the answer paper, a clear statement of any assumptions made.
2. This is a CLOSED BOOK EXAM.
No calculator is permitted.
3. Six (6) questions constitute a complete exam paper.
The first six questions as they appear in the answer book will be marked. Put a diagonal line through a completed question if you do not want it marked.
4. Each question is of equal value. Select the questions where you can provide the most information when answering the question.
5. Each question should take about half an hour.
6. All questions require an answer in essay format. Clarity and organization of the answer are important. Please write legibly, as we can only grade what we can understand. Use diagrams wherever appropriate.

Marking Scheme

Each of the six questions selected is worth 16.66 percent of the total mark.

Choose six (6) of the following ten (10) questions:

1. What is the physical property that is usually most important for the magnetic method? Describe a way that this physical property can be measured for a hand-sample specimen in the laboratory or in the field. What are the strengths and weaknesses of this measurement method? Give some typical values of the physical property for two types rocks AND two minerals or two types of buried material. What is the other physical property sometimes important in the magnetic method?
2. The earth's magnetic field varies on its surface as a function of latitude. Use a diagram to show the changes in direction and strength. Give typical values of the magnetic field strength and inclination at the magnetic equator and the north and south magnetic poles. What is the magnetic declination and give some examples of typical values at a range of locations?
3. Describe how you would go about planning and executing a gravity survey. Describe strategies for monitoring *and removing* drift of the gravity meter. Explain the effects of earth-tide variations and describe ways that these can be removed.
4. The international gravity formula is intended to compensate for changes in gravity as a function of latitude. Draw diagrams to help to explain why the gravity can change as a function of latitude on a spinning and non-spherical earth.
5. What is the difference between a magnetometer and a magnetic gradiometer? What errors are associated with gradiometer measurements? Why may the measurements from the gradiometer be preferred to the usual measurements from a total field instrument? Give some examples of specific applications from exploration or engineering when gradient measurements would be useful.
6. The earth's magnetic field varies over many time scales from changes over a few milliseconds to changes over millions of years. Give the names of three types of magnetic field variations, the times scales over which they occur, and a brief explanation of the physics that causes the variation. Discuss how some of these changes can impact magnetic field surveys and how their effect can be minimized in survey planning.
7. What is the tilt angle and the tilt derivative of magnetic data? Why are these quantities or transformations applied to magnetic data and how do they assist in the interpretation of magnetic data? What are the disadvantages of these transformations?
8. Discuss a case history where gravity methods have been used to solve a geotechnical or engineering problem. Discuss the reason why gravity methods might have been used rather than other methods, the survey procedure, how the data was processed and interpreted. What were the weaknesses of the survey and/or how might the survey be improved if it was repeated?
9. What is regional residual separation and why is it necessary? Describe in detail a number of different methods used to achieve this separation. What are the underlying assumptions behind these methods?
10. Image processing is an important part of interpreting gravity and magnetic data. Describe the procedures that are used to set the colour stretch (or look up table) and other methods that are used to highlight subtle features in the data. Provide as much detail as you can.