

National Exams December 2019

18-Geol-A7, Applied Geophysics

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.
Approved Casio or Sharp 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. If you later decide you do not want an answer marked, put a single diagonal line through your answer
4. Each question is of equal value.
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. Drawing and labelling diagrams is strongly encouraged, as long as the diagram is explained.

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. Consider the physical properties to which geophysical methods are sensitive. Give specific examples of subsurface materials and the corresponding values of these physical properties. Include example values that are very small and very large. Of these physical properties, which property has a broad range of values and which one has a narrow range? What implication does a broad range have on the corresponding acquisition equipment and the interpretation of the geophysical data collected by the relevant method?
2. Describe a typical target that would be the objective of a gravity survey and the specifications of a survey that you would design to detect this target. Consider the geological setting, terrain, physical property contrasts, signal levels, noise levels, wavelengths, and acquisition procedures.
3. Geophysical data are often interpreted from an image. Describe some of the different methods that the data collected at a number of points on the ground (or in the air) can be converted into an image on a computer screen or map. Describe the different ways that this image can be colored or shaded to highlight certain features. Give some examples of geophysical images and describe the manner that they might be interpreted and what can be extracted from the images.
4. Geophysical techniques are classified as passive and active methods. For the electrical methods describe in as much detail as possible a passive method and an active method. Discuss the manner in which the field is generated or excited in the ground and how the field is measured in a survey. Give examples of when these methods would be appropriate and the results that might be obtained.
5. Discuss the strengths and weaknesses of the gamma-ray spectrometry method of geophysical prospecting and mapping.
6. Manufacturers of electromagnetic systems build equipment in a variety of different styles and configurations. Select three different types of systems and describe the components, their geometric configurations and how the components are moved over the survey area. In each case, give an example of a target for which the system might be used and why the system would be better than another electromagnetic system.
7. Geophysical surveys can be conducted with tools deployed down drill holes. Describe in detail three tools and the principles behind these tools. In each case, give an example of how the data can be used to interpret the geology and how the data can be used to help interpret other geophysical data.
8. What are the procedures used to acquire, process and interpret refraction seismic data? Describe the details of a case when a refraction survey is useful.
9. Reflection seismic methods use a variety of different sources and sensors. Describe typical source/sensor combinations for a) a low cost shallow survey for engineering or geotechnical purposes, b) a deeper survey for oil exploration and c) a marine reflection survey. If the deep survey wanted to see deeper, for example to the Mohorovičić discontinuity, at 35 km depth, what modifications to the survey specifications might make this possible.
10. Describe the basic principles of the magnetotelluric method, the equipment used to acquire the data and the manner in which the data is interpreted.