

National Exams December 2016

04-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.
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.
4. Each question is of equal value.
5. Each question should take about half an hour.
5. All questions require an answer in essay format, however, the use of tables and figures can enhance your answer. Clarity and organization of the answer are important. Please write legibly, as we can only grade what we can understand.

Marking Scheme

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

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Examination Paper

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

1. Describe the choices that must be made when planning a geophysical survey. Give a specific example of a survey to solve a problem with corresponding values for the survey parameters that you consider are appropriate. Discuss the consequences of inappropriate choices for these values.
2. For the seismic reflection method, describe the physical properties that govern wave propagation and how contrasts in these properties result in reflections. Give an example of when the seismic reflection method is applied successfully to a geotechnical or engineering problem. In your example what are the physical property contrasts and what data processing would be most important to successfully interpret the data. Why are these steps more important than the other data processing steps?
3. Select three tools used for geophysical well logging surveys and describe what they measure, how they measure it, and what physical property contrasts they are sensitive to. Give an example of a situation where each tool would be applied to solve a problem.
4. Describe exploration or engineering applications (problems) for which gamma-ray spectrometry surveys are or might be an appropriate geophysical tool. In each case discuss the survey specifications (acquisition platform, survey spacing, etc) that you would use and how you would go about processing and interpreting the data.
5. Describe the difference between electrical and electromagnetic method and discuss their advantages and disadvantages, citing examples where appropriate.
6. What is a Fourier transform and how is it used in the processing and interpretation of geophysical data? Describe some of the pitfalls of the Fourier transform.
7. Give three specific examples of i) an airborne, ii) a ground and iii) a borehole electromagnetic system. In each case provide details of the system name, the transmitter waveform, the receiver operation, the geometric configurations used and other relevant details like normalization and reduction if appropriate. In each case, list some advantages and disadvantages of the system and give an example of when it is most appropriate to use each system.
8. In geophysical data, the features of interest are not always evident in maps or images. List some ways that data can be enhanced in order to see features of interest. In each case, discuss the concept behind the enhancement, how it is achieved and parameters that might be adjusted to get optimal results.
9. Quantitative interpretation of geophysical data involves forward and inverse modelling. Explain the difference between these two types of modelling approaches. Discuss the strengths and weaknesses of each approach and give some example algorithms or programs for each approach. Describe how these modelling approaches might be used in a geophysical program.
10. Geophysical can be used to explore for coal, oil, natural gas, minerals and groundwater. Select one of these applications and list all major geophysical techniques and then discuss the circumstances when each method would be appropriate or inappropriate for the application you selected.