

令和4年度第2次募集
新潟大学大学院自然科学研究科博士前期課程入学者選抜試験問題
Graduate School of Science and Technology, Niigata University
The Second Entrance Examination for the Master's Program
for Academic Year 2022
外国人留学生特別選抜
Entrance Examination for International Students

数理物質科学専攻 Major: Fundamental Sciences

数理科学 Course: Mathematical Science

A3

専門科目（数学）
Specialized subjects（Mathematics）

注意事項 Instructions

1. この問題冊子は、試験開始の合図があるまで開いてはいけません。
Do not open this booklet before the start of the examination is announced.
2. 問題冊子は、表紙を含めて全部で4ページあります。
This booklet consists of a total of 4 pages, including the cover page.
3. 試験時間は、9：00～11：00です。
The examination time is from 9:00 to 11:00.
4. 解答は、すべて解答用紙の指定された箇所に記入すること。
All answers must be written in the designated space on the Answer Sheets.
5. 受験番号は、各解答用紙の指定された箇所に必ず記入すること。
Your examinee's No. must be written in the designated space of each Answer Sheet.
6. 下書きは、問題冊子の余白を使用してください。
Please use a blank space of this booklet, if necessary.

Problem 1

Find the eigenvalues and eigenvectors of the following matrix A .

$$A = \begin{pmatrix} 0 & 2 & -2 \\ 2 & 0 & 2 \\ -2 & 2 & 0 \end{pmatrix}$$

Problem 2

Consider the real-valued function

$$f(x, y) = 2x^2 - 2xy + 3y^2 - 4x - 8y.$$

Solve the following problems.

(1) Calculate the partial derivatives $\frac{\partial}{\partial x} f(x, y)$ and $\frac{\partial}{\partial y} f(x, y)$.

(2) Give the Hessian matrix $\nabla^2 f(x, y) = \begin{pmatrix} \frac{\partial^2}{\partial x^2} f(x, y) & \frac{\partial^2}{\partial y \partial x} f(x, y) \\ \frac{\partial^2}{\partial x \partial y} f(x, y) & \frac{\partial^2}{\partial y^2} f(x, y) \end{pmatrix}$.

(3) Locate all relative extrema of f .

Problem 3

Write your research plan in the graduate school in English.